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LATE WINTER AND SPRING FISHERIES INVESTIGATIONS IN THE OLDMAN RIVER DAM STUDY AREA

R.L. & L. ENVIRONMENTAL SERVICES LTD.

LATE WINTER AND SPRING FISHERIES INVESTIGATIONS IN THE OLDMAN RIVER DAM STUDY AREA

Prepared for
ALBERTA ENVIRONMENT
Planning Division

by
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EXECUTIVE SUMMARY

BACKGROUND

On 8 August 1984, the Government of Alberta announced that a dam would be constructed on the Oldman River at the Three Rivers site, northeast of Pincher Creek. A dam has been under consideration for many years due to the extensive, and ever-increasing demand for irrigation and low-flow augmentation of water supplies. The dam will be designed and operated to optimize various multipurpose objectives, however, the major purpose will be to satisfy present and future irrigation needs. The project will affect aquatic habitat, fish populations and resource use patterns in the region. For this reason, Alberta Environment has commissioned studies to determine the type, extent, and distribution of these impacts and to develop effective mitigation strategies. This report combines the results of two field studies conducted in the Oldman River Dam Study Area:

Part A - Winter Fishery Investigation (February-March 1986), and

Part B - Spring Fishery Investigation (April 1986).

The major objective of the late winter study was to delineate, describe, and quantify sportfish overwintering habitats in sections of the Crowsnest, Oldman, and Castle rivers subject to inundation by the Oldman River Dam and in representative sections situated upstream of the reservoir flood level. The major purposes of the spring study were to 1) delineate and describe rainbow trout spawning areas and 2) provide further documentation of the distribution and relative abundance of sportfish populations in the study area. Field work was conducted during the following periods: late winter (3-4 February and 6-12 March 1986) and spring (8-16 April 1986).

LATE WINTER STUDY

Information specifically relating to overwintering use of study streams was not collected during the late winter survey. This was largely due to the type of spring breakup and flood conditions which prevailed in late February and early March 1986. Despite these data limitations, considerable information was obtained on early spring fish distribution patterns and relative abundance in the various study reaches. Data collected in early March indicated that mountain whitefish were present in all systems, but were particularly numerous in the Crowsnest River. Overall, mountain whitefish

contributed approximately 90% to the total sportfish catch. It appears that large numbers of mountain whitefish had recently entered the study area, for feeding purposes. Studies conducted in fall 1985 (O'Neil and Hildebrand 1986) detected a major outmigration of mountain whitefish to downstream situated overwintering areas (i.e., likely in lower reaches of the Oldman River). Rainbow trout were captured in all study streams but were most abundant in the Crowsnest River; they contributed approximately 8% to the total sportfish catch in the March survey. The presence of numerous rainbow trout in the Crowsnest River during early March suggests that overwintering occurred in this system; however, the possibility of early spring movements into the area prior to the survey cannot be discounted. Further evidence to suggest overwintering in the Crowsnest River was provided by 1) the substantial numbers of rainbow trout captured in the Crowsnest River during October 1985, and 2) the limited tag recapture data supporting the occurrence of defined movements between the Crowsnest River and Oldman River. Although suitable overwintering habitat for rainbow trout occurred within the studied sections of the Oldman and Castle rivers, the extent of use is uncertain. Brown trout, which contributed 0.6% to the total sportfish catch, are thought to be largely resident in the Crowsnest River, although occasional straying into the Oldman River is acknowledged. Bull trout were encountered in the Oldman and Castle rivers, but on an infrequent basis. This species contributed only 0.6% to the total sportfish catch in the study area during the March survey. Several non-sport species also were encountered, including longnose sucker, white sucker, mountain sucker, and burbot. Of these, longnose sucker was the most common.

SPRING STUDY

Rainbow trout spawning areas were identified only in the Crowsnest River. A total of 35 redds were located in this system; all but two were situated upstream of the reservoir Full Supply Level (FSL). Electrofishing data (i.e., captures of adult rainbow trout in spawning condition) also indicated that the majority of spawning was situated in the upper Crowsnest River (i.e., above FSL). The number of redds identified is an underestimate of the total spawning activity in the system since 1) spawning was still in progress at the termination of field studies, and 2) low water clarity in the latter stages of the sampling period did not allow visual redd enumeration. The redds identified were generally situated at depths of 30-40 cm and mean velocities ranged between 70 and 90 $cm \cdot s^{-1}$. Spawning substrates were dominated by materials in the "coarse" to "very coarse" gravel range (1.6 cm - 6.4 cm diameter). Although redds were not observed in

the Oldman or Castle rivers, low numbers of adult rainbow trout in spawning condition were located. Based on these captures, three possible spawning sites were identified in the north fork of the Oldman River and six in the Castle River.

In addition to rainbow trout, other species encountered in the April survey included: mountain whitefish, brown trout, bull trout, longnose sucker, and white sucker. As in previous surveys, mountain whitefish was the dominant species in the study area.

PART A

Late Winter Fisheries Investigation
(February-March 1986)

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SECTION 1.0
INTRODUCTION

1.1 BACKGROUND

Fisheries studies are presently being conducted in the Oldman River Dam Study Area to provide baseline and impact related data on fish and habitat resources. This information will form the basis for a mitigation plan for the Oldman River Dam. Studies have been completed or are in progress relating to impacts and possible mitigation options associated with fish migration blockage, and affected feeding/holding and rearing habitats upstream and downstream of the dam. There was further concern that information on overwintering use of the study area by sportfish species was lacking. This study was commissioned by Alberta Environment in order to alleviate these concerns within the flooded area and in peripheral habitats above the Reservoir Full Supply Level (FSL).

1.2 STUDY AREA

The study area included directly affected (i.e., innundated) and adjacent upstream reaches of three river systems: the Oldman River, the Castle River, and the Crowsnest River (see Figures 5.10-5.12, Part B). Fisheries and habitat studies on the mainstem Oldman River extended from the North Fork Bridge to the damsite, a distance of approximately 36 km. Of this total, approximately 22 km are situated within the area of innundation and 14 km are situated in the adjacent upstream reach. The Castle River was investigated from its confluence with the Oldman River upstream to the confluence of Mill Creek, a distance of approximately 24 km. The study section included approximately 12 km within the potentially flooded area and approximately 12 km of the adjacent upstream reach. The Crowsnest River was investigated from Lundbreck Falls downstream to the confluence with the Oldman River, a distance of approximately 16 km. The study section included approximately 9 km within the potential flood zone and an additional 7 km upstream. Approximately 76 km of riverine habitat were located within the overall study area, including 33 km above and 43 km below the Full Supply Level (FSL).

SECTION 2.0
STUDY OBJECTIVES

The specific terms of reference for the "Winter Fisheries Survey Upstream of Oldman River Damsite" study, as outlined by Alberta Environment (letter of 10 February 1986), were as follows:

1) Determine the winter distributions and relative abundance of rainbow trout, brown trout, and mountain whitefish within the proposed reservoir area and immediately upstream of FSL in the Oldman, Castle and Crowsnest rivers.
2) Describe the overwintering habitat requirements of sport species of fish through field observations.
3) Determine if these habitat types are presently limiting within the study area.
4) Quantify the amount of overwintering habitat expected to occur in the reservoir area and describe the extent of its use by fish species.
5) Submit three (3) copies of a final report with relevant documentation outlining the work program and results. An unbound camera-ready copy suitable for reproduction must also be provided.

SECTION 3.0
METHODOLOGY

3.1 SCHEDULING AND STREAM CONDITIONS

A field inspection was conducted on 3 and 4 February to determine extent of ice cover, the distribution of open water reaches, and to develop a sampling strategy. The entire study area was viewed from the air (Cessna 180 aircraft); additional ground surveys were conducted on the Crowsnest River. Ice cover was extensive (i.e., only minor open water areas noted) in all stream reaches with exception of the upper Crowsnest River (above Highway No. 3). This particular reach exhibited considerable open water, particularly in high gradient sections. In view of the large study area and the irregularity of the ice surface (ice heaving, perched bank ice, etc.) which would restrict access and sampling effectiveness, particularly in the Castle River, it was decided that the most efficient course of action would be to conduct a sampling program immediately after ice-out. The intent was to obtain fish distribution data prior to the occurrence of seasonal fish movements by means of a systematic boat-electrofishing program.

Ice-out on the study streams occurred rapidly in late February, and was associated with a major flood event (Table 3.1). Sampling was carried out during the period 6-12 March, after the flood peak had subsided. The occurrence of a high flow period prior to the fisheries survey raises concerns as to the validity of the fish distribution data in an overwintering context (see Section 4.2).

3.2 STUDY METHODOLOGY

3.2.1 FISH CAPTURE AND TAGGING

Fish sampling was conducted by a two man survey crew utilizing boat electrofishing techniques. The electrofishing system consisted of a Smith-Root MV1A boat electrofisher powered by a 4000-W Honda generator. Sampling was carried out in a shallow-draft inflatable boat (Zodiac Mark IV). Operational procedures and sample sections were identical to those utilized in the summer/fall 1985 study (O'Neil and Hildebrand 1986). The methods of calculating electrofishing CPUE are described in detail in Part B (Section 4.2) of the report.

All sportfish of taggable size (i.e., exceeding 250 mm) were tagged with orange Floy FD67 Anchor Tags provided by Alberta Environment. The tags were coded with a 6 digit number and the following lettering: "Alta. Env. Reward". Details of the tagging procedure are provided in O'Neil and Hildebrand (1986).

3.2.2 LIFE HISTORY DATA

Pertinent life history data were collected from a representative sample of the various sportfish species and size classes; the data included fork length, weight, and sex and maturity (externally or through dissection of capture mortalities). This information was obtained to supplement and verify existing data (O'Neil and Hildebrand 1986). Scales were collected from a representative sub-sample and sagittal otoliths were removed from all capture mortalities. Methods of ageing and data handling were similar to those utilized in the earlier study.

Table 3.1 Selected stream discharge data for the Oldman River Dam Study Area, February-March 1986.

Stream	Station	Stream Discharge Data ($m^3 \cdot s^{-1}$)[a]			
		Site Inspection	Ice Out/Flood Conditions		Fish Survey Flows
			Baseflow	Peak	
Crowsnest R.	Frank	1.68 (3 Feb.)	1.65 (23 Feb.)	9.56 (26 Feb.)	4.54 (6 March)
Castle R.	Beavermines	4.44 (3 Feb.)	3.12 (23 Feb.)	35.7 26 Feb.)	17.20 (7 March)
Oldman R.	Waldrons Corner	3.09 (3 Feb.)	1.60 (23 Feb.)	8.0 (25 Feb.)	5.30 (10 March)
Oldman R.	Brocket	8.10 (3 Feb.)	4.5 (23 Feb.)	250.0 (24 Feb.)	33.1 (12 March)

[a] Based on preliminary Water Survey of Canada data.

SECTION 4.0
STUDY RESULTS

4.1 SPECIES COMPOSITION AND STATUS

Fish sampling was conducted in the study area during the period 6-12 March 1986. A total of 2868 sportfish were captured during the survey (Table 4.1). Approximately 73% of the collected fish were from the Crowsnest River; the remainder were from the Oldman River (25%) and the Castle River (2%). Sampling effort (electrofisher operating time) in the various study reaches was as follows: Crowsnest River - 160.48 min.; north fork of the Oldman River - 217.32 min; main Oldman River - 146.50 min.; and Castle River -115.69 min. The principal sportfish encountered was mountain whitefish; this species contributed approximately 90% to the total sportfish catch. Rainbow trout were second in abundance, contributing 8.0% to the enumerated total. The remainder of the sportfish total was made up of brown trout (0.6%) and bull trout (0.6%).

The presence of the larger, non-sport species (i.e., longnose sucker, white sucker, mountain sucker, and burbot) was also recorded during the survey. Adult longnose sucker were common in the lower Crowsnest River (section ES1) and were all but absent from the upper reaches. They were present only on an occasional basis in the north fork of the Oldman River but were more common in the main Oldman River (i.e., below Crowsnest River confluence). Longnose sucker adults were encountered only occasionally in the Castle River. White sucker adults were not recorded in the Crowsnest or Castle rivers but were common (although only locally numerous) in the Oldman River below the Crowsnest River confluence. White suckers were captured on an infrequent basis in the north fork of the Oldman River. Mountain suckers occurred throughout the study area on a sporadic basis; none were encountered in the Crowsnest River. Only one burbot was captured, that being an individual collected from the Oldman River below the Crowsnest River confluence.

The electrofishing results obtained for the three river systems are presented in Table 4.2. The CPUE data reflects the dominant status of mountain whitefish in each of the systems and the greater abundance, in the Crowsnest River, of the three major sportfish species (mountain whitefish, rainbow trout, brown trout). The data also provides insight into the linear distribution of fish in the Crowsnest and Oldman rivers during early March. Brown trout in the Crowsnest River were somewhat more abundant

Table 4.1 Numbers and percentage composition of sportfish encountered in the Oldman River Dam Study Area, March 1986.

Stream	Species Abundance and Percentage Composition									
	Brown trout		Rainbow trout		Bull trout		Mountain whitefish		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Crowsnest River	13	0.6	161	7.7	-	-	1914	91.7	2088	100
Oldman River	3	0.4	52	7.4	11	1.6	640	90.6	706	100
Castle River	-	-	15	20.3	7	9.5	52	70.2	74	100
Total	16	0.6	228	8.0	18	0.6	2606	90.8	2868	100

Table 4.2 Summary of boat electrofishing catch and CPUE for major sportfish species in the Oldman River Dam Study Area, March 1986.

Section	Location (km)	Date	Sample Effort (min.)	Sample Distance (km)	Catch and CPUE (catch/km and catch/min)								
					Brown trout			Mountain whitefish			Rainbow trout		
					No. Caught	Catch/ km	Catch/ min.	No. Caught	Catch/ km	Catch/ min.	No. Caught	Catch/ km	Catch/ (min.)
CROWSNEST RIVER													
ES1	0.0-4.1	9 March	42.0	4.1	4	0.98	0.10	183	44.63	4.35	20	4.89	0.48
ES2	4.1-9.1	9 March	48.2	5.0	5	1.00	0.10	524	104.80	10.85	56	11.2	1.16
ES3A	9.1-12.6	6 March	36.6	3.5	3	0.86	0.08	544	155.42	14.85	30	8.57	0.82
ES3	12.6-15.4	6 March	33.6	2.8	1	0.36	0.03	663	236.78	19.73	55	19.64	1.63
Combined	**0.0-15.4**		**160.4**	**15.4**	**13**	**0.84**	**0.08**	**1914**	**124.28**	**11.93**	**161**	**10.45**	**1.00**
OLDMAN RIVER													
ES1A	317.0-331.5	9,11,12 March	146.5	14.5	2	0.13	0.01	480	33.10	3.28	14	0.97	0.10
ES1	331.7-339.0	11 March	86.8	7.3	1	0.14	0.01	78	10.68	0.90	13	1.78	0.15
ES2A	339.0-345.0	10 March	61.5	6.0	-	-	-	24	4.00	0.39	12	2.00	0.20
ES2	345.0-351.4	10 March	69.0	6.4	-	-	-	58	9.06	0.84	13	2.03	0.19
Combined	**317.0-351.4**		**363.8**	**34.2**	**3**	**0.09**	**0.01**	**640**	**18.71**	**1.76**	**52**	**1.52**	**0.14**
CASTLE RIVER													
ES1	0.8-14.9	7 March	115.7	14.1	-	-	-	52	3.69	0.45	15	1.06	0.13

in the lower and middle reaches (ES1 and ES2). In contrast, mountain whitefish increased in abundance in an upstream direction. Very high population densities were encountered in the upper survey reaches (i.e., ES3A, ES3).

In the Oldman River, mountain whitefish were most abundant below the Crowsnest River confluence (section ES1A). In the north fork of the Oldman River (i.e., above Crowsnest River confluence) they were widely distributed, but were not overly abundant. Within the north fork numbers were lowest in ES2A; this sample section includes a canyonous reach of generally low habitat suitability (i.e., steep gradient, limited feeding/holding microhabitats). Limited numbers of mountain whitefish were recorded in the lower Castle River study section (ES1); the upper sample section (ES2) was not sampled due to high flow conditions.

Rainbow trout were abundant in the Crowsnest River, particularly in the upper and middle study sections (i.e., ES3 and ES2). In the Oldman River (north fork and main), rainbow trout exhibited a widespread distribution but were recorded in relatively low numbers. Sampling results from the lower Castle River (ES1) indicated the presence of only small numbers of rainbow trout and a very localized distribution.

Bull trout (sub-adults and adults) were encountered in the Oldman and Castle rivers (Table 4.1). Both adults and sub-adults occurred periodically both in the north fork and main branches of the Oldman River (downstream as far as the proposed damsite). Bull trout (mainly sub-adults) were encountered on a sporadic basis in the lower Castle River.

4.2 FISH DISTRIBUTION AND RELATIVE ABUNDANCE

4.2.1 GENERAL

Due to the flow events (i.e., breakup, major flood, and open water) that occurred in the 10 days prior to the field survey, observed fish distribution patterns likely do not reflect overwintering use. This is based on the premise that upstream feeding movements may have been extensive prior to the 6-12 March 1986 sampling period; fish capture results tend to support this contention. As a result, habitat utilization data may be more representative of an early spring feeding/holding distribution.

4.2.2 CROWSNEST RIVER

A comparison of capture statistics from the March survey to those obtained in October 1985 indicate that a major immigration of mountain whitefish into the

Crowsnest River had recently occurred (Table 4.3). This conclusion is based on the fact that numbers recorded in the March survey were substantially higher than in October. Abundance increased in an upstream direction with highest densities being recorded in section ES3 (Highway 3 to Lundbreck Falls). It is evident that the Crowsnest River provides an important early spring feeding function (in addition to the extensive summer feeding function described in the earlier study) for a large and mobile mountain whitefish population. It is assumed that the whitefish originated from overwintering areas situated in the main Oldman River (i.e., below the Crowsnest River confluence).

Brown trout and rainbow trout were well represented in the electrofishing catch in March; this was particularly true for rainbow trout. This may indicate that these populations are largely resident (i.e., overwinter in the Crowsnest River), or alternatively, that they had returned prior to the early March survey. The latter possibility cannot be discounted since other species had evidently re-entered the system prior to the survey (e.g., mountain whitefish, longnose sucker). However, the absence of tag-recapture data in the study area affirming interstream movements also suggests that the populations are largely resident in the Crowsnest River. Minor straying into the north fork and main branches of the Oldman River for feeding (and possibly overwintering), however, is acknowledged.

4.2.3 OLDMAN RIVER

Fish capture data (Table 4.2) indicated that mountain whitefish were relatively abundant in the Oldman River, below the Crowsnest River confluence (section ES1A). Comparable data for the October 1985 period are not available (i.e., only a small portion of section 1A sampled); however, limited sampling in the reach detected relatively low numbers of mountain whitefish. The data suggests, then, that mountain whitefish had moved into the area prior to the March survey. Comparing the October 1985 and March 1986 data for the north fork of the Oldman River (ES1) also suggests that mountain whitefish had re-entered the system, possibly from overwintering areas in the lower Oldman River (Table 4.4). Rainbow trout numbers in the Oldman River (north fork and main branches) in March appeared to be lower than in October. However, due to small sample sizes the difference may be insignificant. Based on available data it appears that overwintering on a major scale (i.e., of a system wide importance) by mountain whitefish and rainbow trout does not occur in the north fork of the Oldman River. However, overwintering of a relatively small resident population of rainbow trout (and possibly by small numbers of mountain whitefish) is apparent.

Table 4.3 Comparison of October 1985 and March 1986 electrofishing catch and CPUE[a], Crowsnest River.

Sample Section	Date	Brown trout		Mountain whitefish		Rainbow trout	
		No.	CPUE	No.	CPUE	No.	CPUE
ES1	4 Oct.	2	0.49 (0.06)	136	33.17 (3.91)	35	8.54 (1.01)
	9 March	4	0.98 (0.10)	183	44.63 (4.35)	20	4.89 (0.48)
ES2	4 Oct.	11	2.20 (0.32)	37	7.40 (1.08)	41	8.20 (1.19)
	9 March	5	1.00 (0.10)	524	104.60 (10.85)	56	11.20 (1.16)
ES3A	5 Oct.	4	1.74 (0.20)	6	2.60 (0.30)	9	3.91 (0.45)
	6 March	3	0.86 (0.08)	544	155.42 (14.85)	30	8.57 (0.82)
ES3	5 Oct.	5	1.79 (0.18)	222	79.29 (8.04)	27	9.64 (0.98)
	6 March	1	0.36 (0.03)	663	236.78 (19.73)	55	19.64 (1.63)
Combined	October	22	1.55 (0.19)	401	28.24 (3.43)	112	7.89 (0.96)
	March	13	0.84 (0.08)	1914	124.28 (11.93)	161	10.45 (1.00)

[a]Catch per unit effort: fish/km (fish/minute).

Table 4.4 Comparison of October 1985 and March 1986 electrofishing catch and CPUE[a], Oldman River (north fork) and Castle River.

Sample Section	Date	Brown trout		Mountain whitefish		Rainbow trout	
		No.	CPUE	No.	CPUE	No.	CPUE
Oldman River (north fork)							
ES1	19 Oct.	-	- -	34	4.66 (0.51)	18	2.47 (0.27)
	11 March	1	0.14 (0.01)	78	10.68 (0.90)	13	1.78 (0.15)
Castle River							
ES1	10 Oct.	-	- -	17	1.28 (0.16)	14	1.05 (0.13)
	7 March	-	- -	52	3.69 (0.45)	15	1.06 (0.13)

[a]Catch per unit effort: fish/km (fish/minute).

4.2.4 CASTLE RIVER

Sportfish populations in the Castle River during early March were relatively low; this is consistent with the findings in previous seasonal surveys (O'Neil and Hildebrand 1986). Table 4.4 compares CPUE data obtained in October 1985 to that collected in March 1986. The data suggests a slight increase in mountain whitefish abundance in March 1986 relative to October 1985. This was likely due to immigration of fish from overwintering areas situated outside the study section. Although supportive data is limited, it appears that the mountain whitefish population in the Castle River may be at least partially supported by individuals originating from the Oldman River. Rainbow trout numbers encountered in the October 1985 and March 1986 surveys were low and of comparable magnitude. It appears that overwintering use of the Castle River is restricted to use by a relatively small resident population of rainbow trout and possibly by small numbers of mountain whitefish (i.e., no overwintering use of regional significance).

4.3 MICROHABITAT SELECTION

4.3.1 CROWSNEST RIVER

Microhabitat preferences of sportfish in the Crowsnest River appeared to reflect feeding and holding requirements, rather than being related to overwintering or future spawning activity (i.e., rainbow trout). The distribution and characteristics of these feeding/holding microhabitats (Appendix A) in the Crowsnest River was described in detail by O'Neil and Hildebrand (1986). These investigators determined that rainbow trout and brown trout (particularly the larger adults) displayed a strong preference for high quality run and pool holding areas (i.e., R1 and P1 microhabitats). Smaller adults and juveniles inhabited a wider range of types including high quality runs/pools (i.e., R1, P1), rapid/boulder garden (RA/BG) and moderate quality runs (R2, R2/BG). A similar distribution pattern was noted in the present survey; however, the larger rainbow trout (and to a lesser extent brown trout) displayed wider preferences in habitat selection. These individuals were often encountered in shallow riffle/boulder garden (RF/BG) and moderate quality run/boulder garden (R2/BG) microhabitats; in many cases these areas were situated within reasonable proximity to R1 or P1 holding areas. It is possible that these shallow microhabitats were made more attractive for feeding/holding by the presence of moderately increased turbidity levels and flows (i.e., improved cover characteristics). Examination of stomach contents from a sub-sample of rainbow trout

indicated that the fish were actively feeding; a variety of invertebrates were consumed but plecopterans (largely pteronarcids) were the dominant food items.

Mountain whitefish were encountered in a wide range of microhabitats. Larger adults were often associated with high quality holding areas (i.e., R1 or P1) but also showed a noticeable preference for R2 and R2/BG areas. Sub-adults were abundant in shallower, boulder-garden associated microhabitats (e.g., RF/BG, R3/BG, RA/BG). Feeding and holding habitat utilization patterns were similar to those identified in the summer and fall of 1985 (O'Neil and Hildebrand 1986).

4.3.2 OLDMAN RIVER

Microhabitat preferences displayed by sportfish species for feeding/holding in the Oldman River during the March 1986 survey were similar to those determined in the summer/fall 1985 survey (O'Neil and Hildebrand 1986). Adult rainbow trout, brown trout, and bull trout were most often associated with high quality holding areas (i.e., R1, P1); however, moderate quality runs (R2) and rapids (RA) associated with boulder garden (BG) habitats also were utilized. Mountain whitefish were generally associated with R2, R2/BG, RA/BG, and R3/BG microhabitats.

4.3.3 CASTLE RIVER

Rainbow trout captured in the Castle River were very site specific in terms of habitat selection. They were almost always encountered in direct association with high quality holding areas (i.e., R1, P1). This is likely reflects the low habitat suitability of adjacent microhabitats (e.g., high current velocity, low cover) and the low overall population density. Mountain whitefish generally selected R2/BG, RA/BG habitats. Similar distribution patterns for rainbow trout and mountain whitefish were determined in summer and fall 1985 (O'Neil and Hildebrand 1986).

4.4 TAG RECAPTURE SUMMARY

A total of 15 tagged sportfish were recaptured in the Oldman River Dam Study Area during the period 6-12 March 1986 (Table 4.5). The distribution by species was as follows: rainbow trout (eight), brown trout (three), mountain whitefish (three), and bull trout (one). Ten of the fish (eight rainbow trout and two brown trout) were both tagged

Table 4.5. Sportfish recaptured in the Oldman River Dam study area, March 1986 by R.L. & L. Environmental Services Ltd.

Tag No.	Release River	Release Location (km)	Release Date	Release Length (mm)	Recapture River	Recapture Location (km)	Recapture Date	Recapture Length (mm)
				Rainbow Trout				
1645	Crow	6.3	22 Aug./85	340	Crow	5.8	9 Mar./86	354
1729	Crow	13.0	24 Sep./85	446	Crow	13.0	6 Mar./86	440
7872	Crow	10.3	5 Oct./85	423	Crow	10.0	6 Mar./86	425
7902	Crow	3.1	4 Oct./85	495	Crow	2.5	9 Mar./86	500
7961	Crow	7.8	4 Oct./85	336	Crow	13.5	6 Mar./86	342
7988	Crow	5.8	4 Oct./85	423	Crow	5.5	9 Mar./86	424
8886	Crow	13.0	17 Oct./85	305	Crow	12.5	6 Mar./86	312
8889	Crow	13.0	17 Oct./85	328	Crow	10.0	6 Mar./86	328
				Brown Trout				
1387	Old	335.9	18 Aug./85	321	Old	331.8	11 Mar./86	328
1660	Crow	5.8	22 Aug./85	439	Crow	5.5	9 Mar./86	440
1661	Crow	5.8	22 Aug./85	460	Crow	9.4	6 Mar./86	465
				Mountain Whitefish				
1530	Crow	12.6	20 Aug./85	318	Old	320.9	12 Mar./86	313
1591	Old	345.0	21 Aug./85	311	Old	345.0	10 Mar./86	314
1772	Old	330.7	19 Oct./85	298	Crow	0.1	9 Mar./86	290
				Bull Trout				
3174[1]	Old	314.0	3 Mar./85		Old	318.0	12 Mar./86	456

[1]Tagged by Environmental Management Associates.

and recaptured in the Crowsnest River; of these, two had been tagged in summer 1985 and six in fall 1985. Two individuals (one brown trout and one mountain whitefish) were tagged (August 1985) and recaptured in the Oldman River. A bull trout was tagged in the lower Oldman River on 3 March by Environmental Management Associates and recaptured in the same general area on 12 March by the present investigators. The two remaining individuals (both mountain whitefish) displayed movement between the Crowsnest and Oldman systems.

Of the eight rainbow trout recaptured in the Crowsnest River, six were recaptured within a short distance of the release location (i.e., generally less than 500 m). In many cases, it appears that fish were tagged and recaptured in the same microhabitat unit (e.g., same R1 or P1 area). This was particularly evident for larger trout (i.e., length greater than 400 mm). Two rainbow trout exhibited significant differences between release and recapture locations (i.e., net downstream movement of 3.0 km and net upstream movement of 5.7 km).

Two brown trout were recaptured in the Crowsnest river. One individual, initially tagged in August 1985, was recaptured in March 1986. This individual was occupying the same microhabitat (R1 - Unit 71) on both occasions. A second individual was recaptured 3.6 km upstream from its point of release in August. A brown trout tagged and released in the north fork of the Oldman River (4.4 km upstream of the Crowsnest River confluence) in August 1985 was recaptured in the north fork near the Crowsnest River confluence (300 m upstream) in March.

Two of the three mountain whitefish recaptures showed significant movement following release. Furthermore, the recaptures provide evidence of interstream movement between the Oldman and Crowsnest rivers. One individual was tagged in the upper Crowsnest River (km 12.6) in August 1985 and was subsequently recaptured in the Oldman River in March 1986 (approximately 10.6 km below the Crowsnest River confluence). It is assumed that this individual was enroute to summer feeding areas in the upper Crowsnest River at the time of recapture. A second individual tagged in the Oldman River in October 1985 (approximately 800 m below the mouth of the Crowsnest River) was recaptured in the lower Crowsnest River (approximately 100 m above the Oldman River confluence) in March. It is speculated that this fish was tagged during the fall outmigration from the Crowsnest River and was recaptured in the spring feeding migration into the Crowsnest River. A specimen tagged in the north fork of the Oldman River (approximately 13.5 km above the Crowsnest River confluence) in August was recaptured at the same location in March.

SECTION 5.0
DISCUSSION

As mentioned in the previous section, information specifically relating to overwintering use of riverine habitats in the study area was not collected in the present study. However, the study did provide valuable information on early spring habitat selection by the major sportfish species and confirmation of earlier study results pertaining to sportfish distribution and abundance in the study area. Collection of repetitive CPUE and tag recapture data provided further insight into the seasonal movement patterns of mountain whitefish in the study area.

Despite the lack of directly relevant data, certain general conclusions can be drawn regarding the distribution and extent of overwintering in the study streams. For example, it is apparent that the major overwintering areas for the extensive mountain whitefish population(s) in the Crowsnest River are situated in the Oldman River. This conclusion is based on the fact that the majority of mountain whitefish had vacated the Crowsnest River by early October (O'Neil and Hildebrand 1986). It is possible that a small portion of the population remains in the Crowsnest River over the winter, mainly in the upper reaches (i.e., based on comparatively higher electrofishing catches in Section ES3 in October 1985). In contrast, rainbow trout and brown trout are assumed to be largely resident in the Crowsnest River. This conclusion is based on the following: 1) both species were abundant in the Crowsnest River during October (i.e., showed no indications of an outmigration to that point in time); 2) both species were abundant in early March suggesting that they had not left the system; 3) suitable overwintering microhabitats are available in the Crowsnest River; and 4) presently available tag recapture data does not indicate defined interstream movements (although minor straying is acknowledged). The possibility that trout returned to the Crowsnest River prior to the March survey cannot be discounted. Furthermore, flows in late fall (and throughout the winter) were well above average which may have affected overwintering patterns. In low flow years, greater outmigration to the Oldman River might occur, however, this is speculative. Information on the distribution, areal extent, and characteristics of potential overwintering microhabitats (i.e., R1 and P1 habitat types) in the Crowsnest River is provided in O'Neil and Hildebrand (1986).

The assessment of overwintering use of the north fork of the Oldman River by sportfish is based on the October 1985 and March 1986 distribution of fish, and the availability of suitable overwintering microhabitats. Based on this data it appears that

overwintering use is largely restricted to the relatively small resident population of rainbow trout and possibly by small numbers of mountain whitefish. Overwintering of limited numbers of bull trout (and possibly the occasional brown trout in the lower reaches) is assumed. Potentially suitable overwintering microhabitats (i.e., based on depth and size parameters) were delineated in the north fork by O'Neil and Hildebrand (1986).

The Oldman River, downstream from the Crowsnest River confluence and down to below the damsite, appears to be of major importance for mountain whitefish spawning and overwintering (O'Neil et al. 1982; O'Neil and Hildebrand 1986; Fernet and Matyakowski 1986). Also it is assumed that the lower Oldman River supports significant overwintering habitat for rainbow trout and small numbers of bull trout and brown trout. O'Neil and Hildebrand (1986) delineated potentially suitable overwintering habitats as far downstream as the damsite, the lower limit of sampling.

The Castle River apparently provides overwintering habitat for relatively small populations of rainbow trout, mountain whitefish, and bull trout. Information on the distribution of potentially suitable overwintering microhabitats in the Castle River is provided in O'Neil and Hildebrand (1986).

SECTION 6.0

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APPENDIX A

Habitat Type Description and Rating

Appendix A
STREAM HABITAT EVALUATION
Habitat Type Description and Rating

A) Riffle - Portion of channel with increased velocity relative to Run and Pool habitat types; broken water surface due to effects of submerged or exposed bed materials; relatively shallow (less than 50 cm) during moderate to low flow periods.

Riffle (RF) - Typical riffle habitat type; limited submerged or overhead cover for juveniles and adult life stages; coarse substrate.

Riffle-Boulder garden (RF/BG) - Riffle habitat type with significant occurrence of large boulders; availability of significant instream cover for juveniles (to lesser extent adults) at moderate to high flow events.

B) Rapids (RA) - Portion of channel with highest velocity relative to other habitat types. Deeper than Riffle; often formed by channel constriction. Substrate extremely coarse; dominated by large cobble and boulder material. Instream cover provided in pocket eddies (P3) and associated with cobble/boulder substrate.

C) Run - Portion of channel characterized by moderate to high current velocity relative to Pool and Flat habitat; water surface largely unbroken. Deeper than Riffle habitat type. Can be diffentiated into four types: deep-slow, deep-fast, shallow-slow and shallow-fast.

Run (Class 1) (R1) - Highest quality Run habitat type. Maximum depth exceeding 1.5 m; average depth 1.25 m or greater. High instream cover at all flow conditions (submerged boulders/bedrock fractures, depth). Generally of deep-slow type (to lesser extent deep-fast) and situated proximal to upstream food production area (i.e., RF, R3).

Run (Class 2) (R2) - Moderate quality Run habitat type. Maximum depth reaching or exceeding 1.0 m but generally in order of 0.75 m. High instream cover during all but low flow events (baseflow). Generally of either deep-fast type or moderately deep-slow type.

Run (Class 2)/Boulder garden (R2/BG) - Moderate quality Run habitat type; presence of large boulders in channel; high instream cover (boulder, bedrock fractures, turbulence) at all but low-flow events (baseflow). Depth characteristics similar to R2; however required maximum depth lower due to cover afforded by boulders.

Run (Class 3) (R3) - Lowest quality Run habitat type. Maximum depth of 0.75 m but averaging only 0.5 m. Low instream cover at all but high flow events. Generally of shallow-fast or shallow-slow types.

Run (Class 3)/Boulder garden (R3/BG) - Similar to R3 in depth and velocity characteristics; presence of large boulders in channel offers improved instream cover during moderate and high flow events.

D) Flat (F1) - Area of channel characterized by low current velocities (relative to RF and Run cover types); near-laminar (i.e., non-turbulent) flow character. Depositional area featuring predominantly sand/silt substrate. Differentiated from Pool habitat type on basis of high channel uniformity and lack of direct riffle/run association. More depositional in nature than Run habitat (sand/silt substrate, lower food production, low cover, etc.).

E) Pool - Discrete portion of channel featuring increased depth and reduced velocity (downstream oriented) relative to Riffle and Run habitat types.

Pool (Class 1) (P1) - Highest quality Pool habitat type. Maximum depth exceeding 1.5 m; average depth 1.25 m or greater; high instream cover at all flow-conditions (submerged boulder, bedrock fractures, depth, bank irregularities). Generally featuring high Riffle and/or Run association (i.e., food input). Often intergrades with deep-slow type of R1.

Pool (Class 2) (P2) - Moderate quality Pool habitat type. Maximum depth reaching or exceeding 1.0 m but generally in order to 0.75 m. High instream cover at all but low flow events (baseflow).

Pool (Class 3) (P3) - Low quality pool habitat type. Maximum depth of 0.75 m but averaging only 0.5 m. Low instream cover at all but high flow events. Includes small pocket eddy type of habitat.

F) Features - Includes instream features that add to diversity and overall habitat quality.

Chutes (CH) - Areas of channel constriction; generally resulting in channel deepening and increased velocity. Associated habitat types are RA, R1, R2.

Ledges (LG) - Areas of bedrock intrusion into the channel; often creates Chutes and Pool habitat.

PART B

Spring Fisheries Investigation
(April 1986)

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SECTION 1.0
INTRODUCTION

1.1 BACKGROUND

On 8 August 1984, the Government of Alberta announced that a dam would be constructed on the Oldman River at the Three Rivers site, northeast of Pincher Creek. A dam has been under consideration for many years due to the extensive, and ever-increasing, demand for irrigation and low-flow augmentation water supplies. The dam will be designed and operated to optimize various multipurpose objectives, however, the major purpose will be to satisfy present and future irrigation needs.

To ensure that environmental concerns were addressed in a systematic and objective manner, Alberta Environment (Planning Division) established a framework for studies (including fishery related studies) through the development of an Environmental Mitigation/Opportunities Plan. The mitigation plan will be completed in four general phases, commencing in 1985 and extending into 1991. The four phases are as follows: 1) Overview and Data Collection Phase; 2) Assessment and Mitigation Design Phase; 3) Implementation Phase; and 4) Monitoring Phase. Too date, baseline fisheries studies have been conducted to determine the extent and significance of impacts resulting from: 1) fish migration blockage at the damsite, and 2) the loss of important/critical habitats (spawning, rearing, feeding/holding, overwintering) for major sportfish species (mainly rainbow trout, mountain whitefish, and brown trout). These studies have been conducted in both the downstream and upstream zones of influence. The present study was commissioned by Alberta Environment in April 1986; the major purpose was to provide detailed information on spring fish utilization patterns in riverine habitats upstream of the damsite. Particular emphasis was placed on the spawning distribution and ecology of rainbow trout.

1.2 STUDY AREA

The study area included directly affected (i.e., innundated) and adjacent upstream reaches of three river systems: the Oldman River, the Castle River, and the Crowsnest River (see Figures 5.10-5.12). Fisheries and habitat studies on the mainstem Oldman River extended from the North Fork Bridge to the damsite, a distance of approximately 36 km. Of this total, approximately 22 km are situated within the area of innundation and 14 are situated in the adjacent upstream reach. The Castle River was investigated

from its confluence with the Oldman River upstream to the confluence of Mill Creek, a distance of approximately 24 km. The study section included approximately 12 km within the potentially flooded area and approximately 12 km of the adjacent upstream reach. The Crowsnest River was investigated from Lundbreck Falls downstream to the confluence with the Oldman River, a distance of approximately 16 km. The study section included approximately 9 km within the potential flood zone and an additional 7 km upstream. Approximately 76 km of riverine habitat were located within the overall study area, including 33 km above and 43 km below the Full Supply Level (FSL).

SECTION 2.0
STUDY OBJECTIVES

The general objectives of the study as outlined by Alberta Environment (letter of 12 April 1986 and 5 March) were as follows:

1. Document the extent of rainbow trout spawning activity in the Crowsnest River, Castle River, and Oldman River above the proposed damsite. The upper study area boundaries will be Lundbreck Falls on the Crowsnest River, the first bridge crossing downstream of the Highway 507 Bridge on the Castle River, and the North Fork Bridge on the Oldman River.
2. Locations of identified rainbow trout redds will be mapped, and measurements made of redd size, proximity to shore, and at active redds, microhabitat parameters (depth, velocity, substrate).
3. Captured fish will be identified to species, and sportfish tagged with an Alberta Environment reward tag prior to release. Depending on field conditions and numbers encountered, sportfish will be either measured to fork length or subjectively classified to life stage (adult, sub-adult, juvenile, young-of-year).
4. Document sportfish species compositions, distributions, and relative abundance in the study streams; relate these data to previous fisheries studies completed in the study area.

SECTION 3.0
APPROACH AND SCHEDULING

Field studies were undertaken in April 1986 to delineate and characterize rainbow trout spawning areas and spring fish distributions in the Oldman River Dam Study Area. The intent was to schedule the survey to coincide with the commencement of rainbow trout spawning in the Crowsnest River, the major study stream. To the extent possible, rainbow trout spawning distribution was determined through visual redd surveys (i.e., bank and float surveys). This was most practical on the Crowsnest River for several reasons: 1) due to the large rainbow trout population; 2) due to the high visibility of redds (i.e., contrast between disturbed and undisturbed substrate); and 3) due to the small channel which allowed more thorough viewing. Potential spawning sites were identified prior to initiating the field studies based on habitat data collected in October 1985 (O'Neil and Hildebrand 1986). This information was used to develop a sampling strategy and stratify sampling effort. In situations where visual redd surveys were not feasible (i.e., Oldman and Castle rivers and Crowsnest River at elevated turbidity levels) boat electrofishing was utilized to determine the distribution of spawning adults. A site with suitable depth-velocity and substrate characteristics and harboring adults in spawning or recently spent condition was considered to be a possible spawning site.

To determine the timing of initiation of the study and to characterize the water temperature regime during the spawning period, daily water temperatures (25 March - 29 April) were recorded in the lower Crowsnest River (km 2.1) by an area resident (S. Westrop). Readings were taken in the morning (generally between 0700-0800 h) and evening (generally between 1800-1900 h) to approximate the daily minimum and maximum temperature values. Based on this information the survey was initiated on 8 April; field work terminated on 26 April.

SECTION 4.0
METHODOLOGY

4.1 FISH CAPTURE AND TAGGING

Fish sampling was undertaken using a shallow-draft inflatable boat (Zodiac Mark IV) and portable electrofisher. The electrofishing system consisted of a Smith-Root MV1A boat electrofisher powered by a 4000-W Honda generator. Pulsed direct current was directed into the water through a hand-held anode. The anode consisted of a 25.4-cm diameter metal ring covered with hardware cloth. The ring was affixed to a circular styrofoam block for floatation and attached with a short length of chain to a 2.0-m insulated wooden pole. The cathode lead was connected to a 1.15-m x 0.33-m section of aluminum sheeting; the aluminum sheet was attached to a similar sized piece of 5.0-cm thick styrofoam. The cathode was allowed to float alongside the boat during sampling. The majority of shocking was conducted with the unit producing 3.0 to 5.0 A.

The electrofishing procedure consisted of drifting downstream through defined sampling sections, generally following the thalweg profile. Sampling was directed towards bank-related or in-stream cover. A crew member positioned on the bow of the boat manipulated the anode pole and netted the fish attracted by the electric field. A second crew member stood at the stern of the boat and controlled the direction of drift. In shallow or boulder-strewn sections it was often necessary for the sternsman to disembark and guide the boat manually.

During boat electrofishing, only sportfish species were netted. Coarsefish and those sportfish avoiding the netter were enumerated and recorded as observed at the end of the sample section. Captured fish were transferred immediately to holding tubs. Fish were processed upon completion of a sample section or when the holding capacity of the tubs was reached. Fresh water was added periodically to replenish the dissolved oxygen supply, moderate water temperatures, and reduce stress. Catch data and habitat residence data for sportfish species and life stages (juveniles, adults) were recorded on a standard Electrofishing Record form. Electrofisher settings, amperage produced, and sampling effort (seconds and metres shocked) also were recorded. Water temperature was recorded with a pocket thermometer to the nearest 0.5°C. Other information recorded included: stream conditions (flows, turbidity levels, etc.), estimated sampling efficiency, and factors limiting sampling efficiency.

In order to provide a comparable data base with previous studies (i.e., fall 1985 and winter 1986), electrofishing survey sections used in the present study, corresponded to those established previously. The locations of the general electrofishing survey sections (designated with the ES suffix) are shown on Figures 5.10 (Crowsnest River), 5.11 (Oldman River), and 5.12 (Castle River).

Sportfish captured by electrofishing were tagged to provide additional data on fish movements in the study area. Only specimens in good physical condition at the time of capture were marked; Floy FD67 Anchor Tags provided by Alberta Environment were used. Tags were coded with a 6 digit number and the words "Alta. Env. Reward". The tag was inserted (using a Dennison Mark II applicator gun) into the dorsal musculature immediately below the insertion of the dorsal fin.

4.2 FISH DISTRIBUTION AND RELATIVE ABUNDANCE

Habitat residence patterns were recorded for sportfish species and life stages during electrofishing runs in the survey sections. Information noted included: habitat type (e.g., Run, Riffle, Rapid, Pool, and Unit Number), association with instream (e.g., boulders) or bankside (e.g., undercut banks, bank fall debris) cover, flow characteristics (i.e., velocity, turbulence), estimated depth, and substrate types. This information was noted by both crew members and recorded at each stop.

The relative abundance of sportfish species was based on electrofishing catch per unit effort (CPUE) values derived for each species and for each of the electrofishing sections. For rainbow trout and brown trout, these values were calculated using the formula:

$$\text{CPUE} = \frac{\text{Total Catch (No. netted)}}{\text{Total Sample Effort in minutes}} \quad \text{or} \quad \frac{\text{Total catch}}{\text{Total distance sampled in km}}$$

CPUE values for mountain whitefish in the Oldman and Castle rivers were calculated in the same manner. In the Crowsnest River however, due to the large numbers of mountain whitefish encountered and the limited holding facilities available, it was practical to net only a representative sample. As a result it was necessary to adjust the actual catch figures to reflect the true status of mountain whitefish. To accomplish this, capture values were increased by an amount equalling 50% of the total

fish observed, but not netted, in a given sample section (i.e., assumes an average netting efficiency of 50%).

4.3 DESCRIPTION OF SPAWNING HABITAT

Detailed habitat evaluations were undertaken at rainbow trout spawning sites. In the Crowsnest River, rainbow trout redds were easily recognizable due to the contrast between the natural, algae covered substrate and the cleaner, disturbed substrate in the redd. Downstream float surveys (i.e., in inflatable boat) and site-specific bank-side surveys (i.e., by foot) provided effective coverage of the Crowsnest River.

Detailed depth, velocity, and substrate information was collected to characterize rainbow trout redds. Depths were recorded at four locations on the perimeter of each redd (at points delineating the maximum length and maximum width of the redd) and at one location in the centre of the redd. Velocity measurements (using a Marsh-McBirney electromagnetic current meter) were taken at the five points; readings were taken at three locations in the water column (i.e., surface, 0.6 of depth, and 10 cm above the bottom). Substrate size/composition was recorded using a 2 m-length of lead line marked in 10 cm increments after the method of Bain et al. (1985). The line was positioned down the centre of the long axis of the redd. A substrate rating code was assigned to the dominant substrate size in each 10 cm increment. Substrate particle sizes were classified according to a modified Wentworth Scale (Platts et al. 1983). The codes and corresponding substrate types and sizes are given below:

Substrate Type	Size (cm)	Code
Silt	-	1
Sand	-	2
Fine gravel	0.2-0.8	3
Medium gravel	0.8-1.6	4
Coarse gravel	1.6-3.2	5
Very coarse gravel	3.2-6.4	6
Small cobble	6.4-12.8	7
Large cobble	12.8-25.6	8
Small boulder	25.6-51.2	9
Large boulder	51.2+	10
Bedrock	-	11

Additional information obtained at spawning areas included: substrate embeddedness (% filling of interstitial space) and algal cover (% surface coverage), distance of the redd to the nearest bank and nearest redd, association with cover, and habitat type (at site, adjacent). The habitat type description and rating system employed is described in Appendix B. Redd locations were mapped and photographed for future reference.

4.4 LIFE HISTORY DATA

Pertinent life history data were collected from a representative sample of the various sportfish species. Fork lengths were recorded to the nearest millimetre; weights were determined on either a Chatillon Model 1038B spring scale (0 to 1000 g) or a Hanson Dietary Scale (0 to 500 g). Sex and maturity were determined either by dissection, external examination (i.e., for brown trout), or, based on the release of sexual products. Scales were removed from a representative sample of the various sportfish; otoliths were removed from sacrificed individuals. Scales and otoliths were placed in coin envelopes.

Life history information was recorded on coded fish data sheets and entered into computer files. The data was sorted and analyzed using FISHPAK (an in-house computer software package) on the University of Alberta Computer (Amdahl 470 V17 under MTS).

SECTION 5.0
STUDY RESULTS

5.1 STREAM CONDITIONS

Hydrographs for the three river systems were very similar (i.e., timing and shape) during the 8-26 April survey period (Figures 5.1-5.4). The flow patterns were characterized by a minor peak on 10 April (approximately) and a more pronounced peak on 23 April. These peaks were separated by a period of reduced flows which occurred in the 15-21 April period (approximately). Mean, maximum, and minimum daily flows ($m^3 \cdot s^{-1}$) for the survey period (8-26 April) are presented below.

	Mean	Max.	Min.
Crowsnest River (at Frank)	7.7	14.6	5.2
Castle River (at Beavermines)	12.7	30.3	7.2
Oldman River (at Waldrons Corner)	15.8	42.0	7.6
Oldman River (at Brocket)	55.8	126.0	35.7

The thermal regime of the lower Crowsnest River (Km 2.1) during the spring period is illustrated in Figure 5.5; the data base is presented in Table A1. As indicated, temperatures in the Crowsnest River during the late March-April period were extremely variable, consisting of a series of peaks and subsequent declines. Major peaks occurred on 8 and 22 April; maximum stream temperatures in the order of 10°C were recorded at the lower Crowsnest River monitoring site on these dates. Minimum daily temperatures exceeded 5°C. Spot temperature readings for these periods indicated the presence of even higher daily maximums (Table A2). For example, a temperature of 13.5°C was registered at Km 4.2 on 21 April (1650 h). A major reversal in the spring warming trend occurred during the period 11-13 April due to an abrupt weather change (i.e., overnight air temperatures of -5 to -10°C). Floating frazil ice and solid ice in backwater areas was noted in all three systems during this period. Diurnal temperature fluctuation in the Crowsnest River was quite pronounced, averaging approximately 6°C during warm weather periods.

Figure 5.1 Crowsnest River Hydrograph.

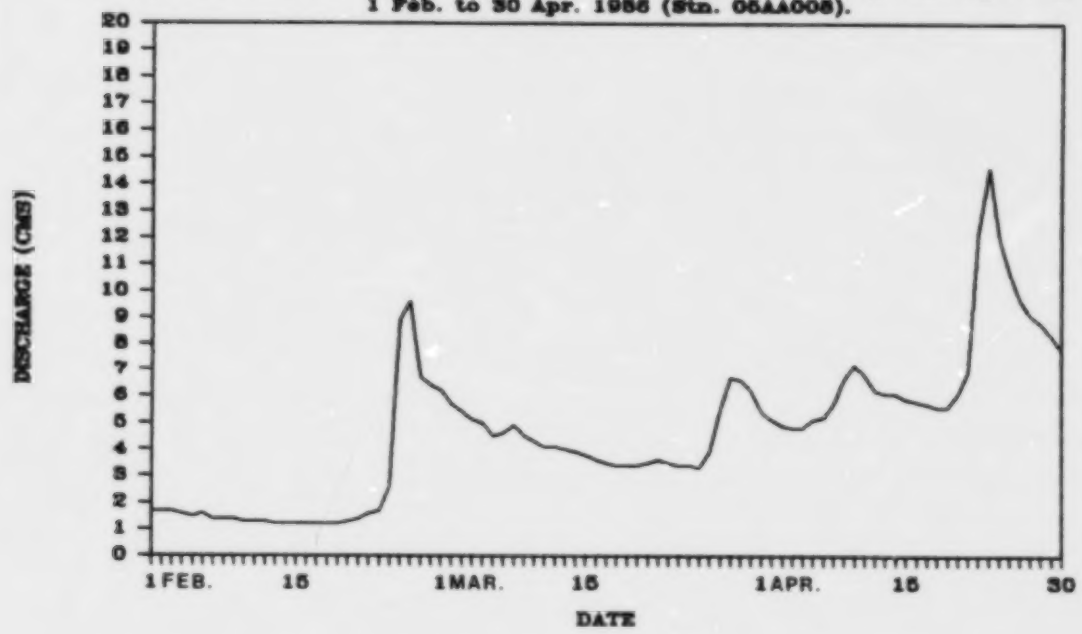


Figure 5.2 Castle River Hydrograph.

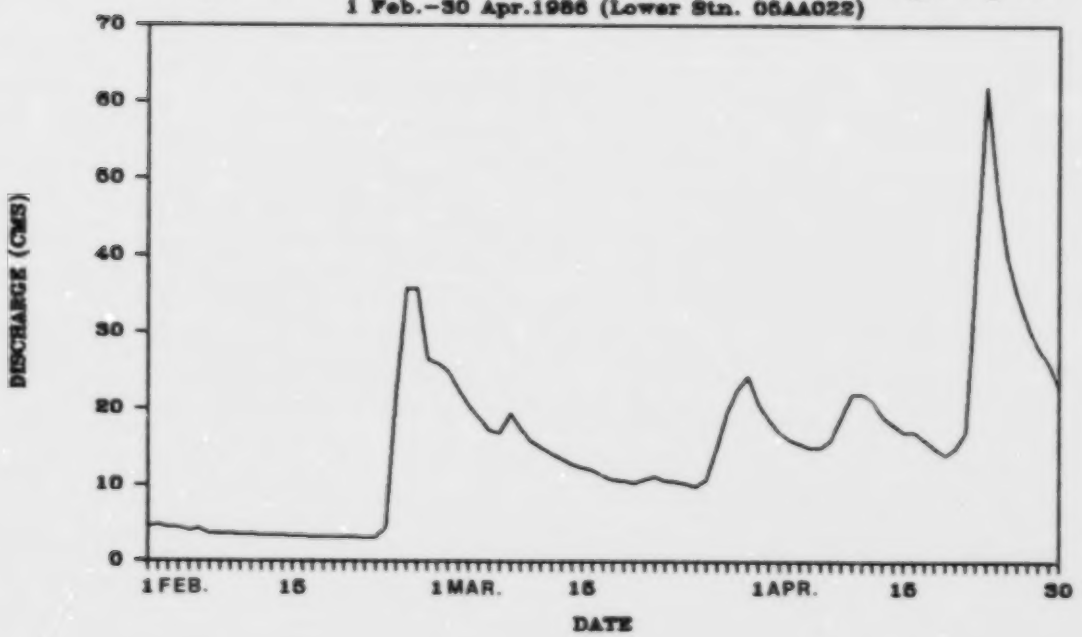


Figure 5.3 Lower Oldman R. Hydrograph.

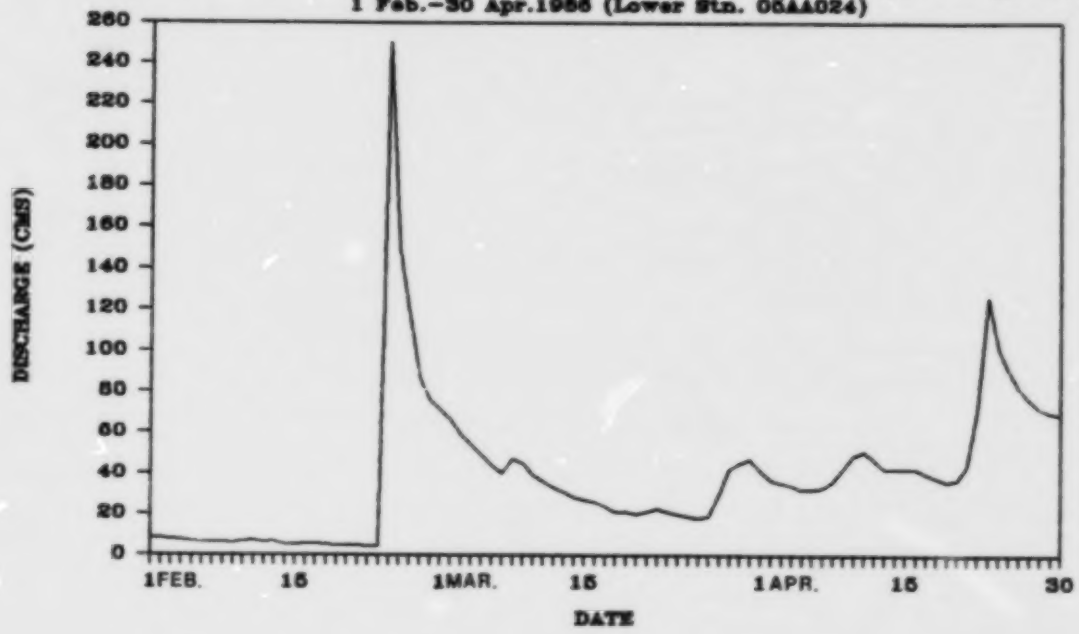


Figure 5.4 Upper Oldman R. Hydrograph

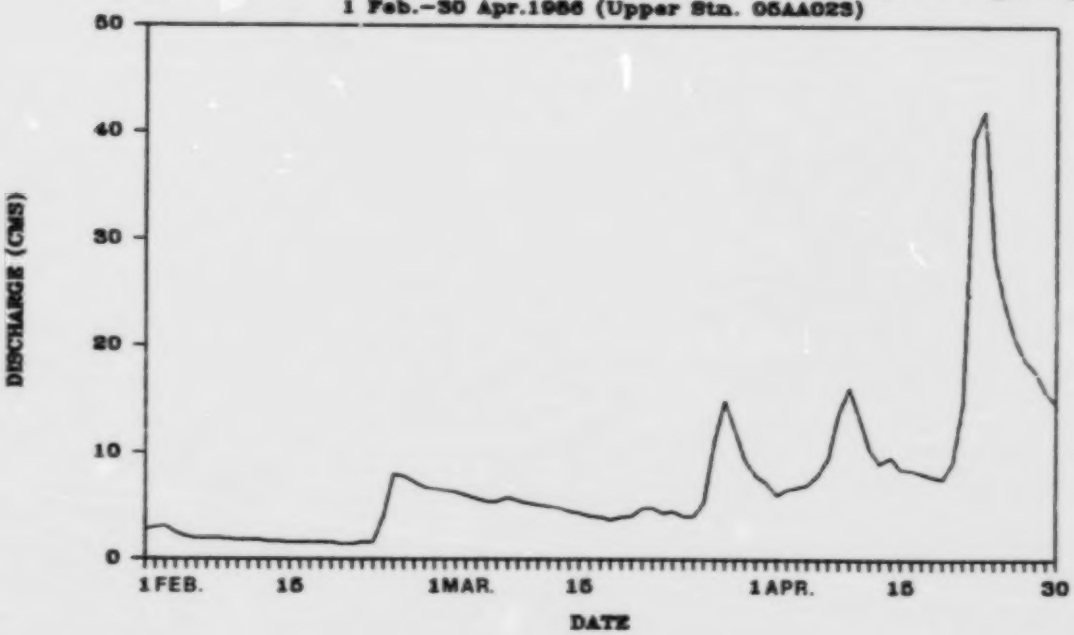
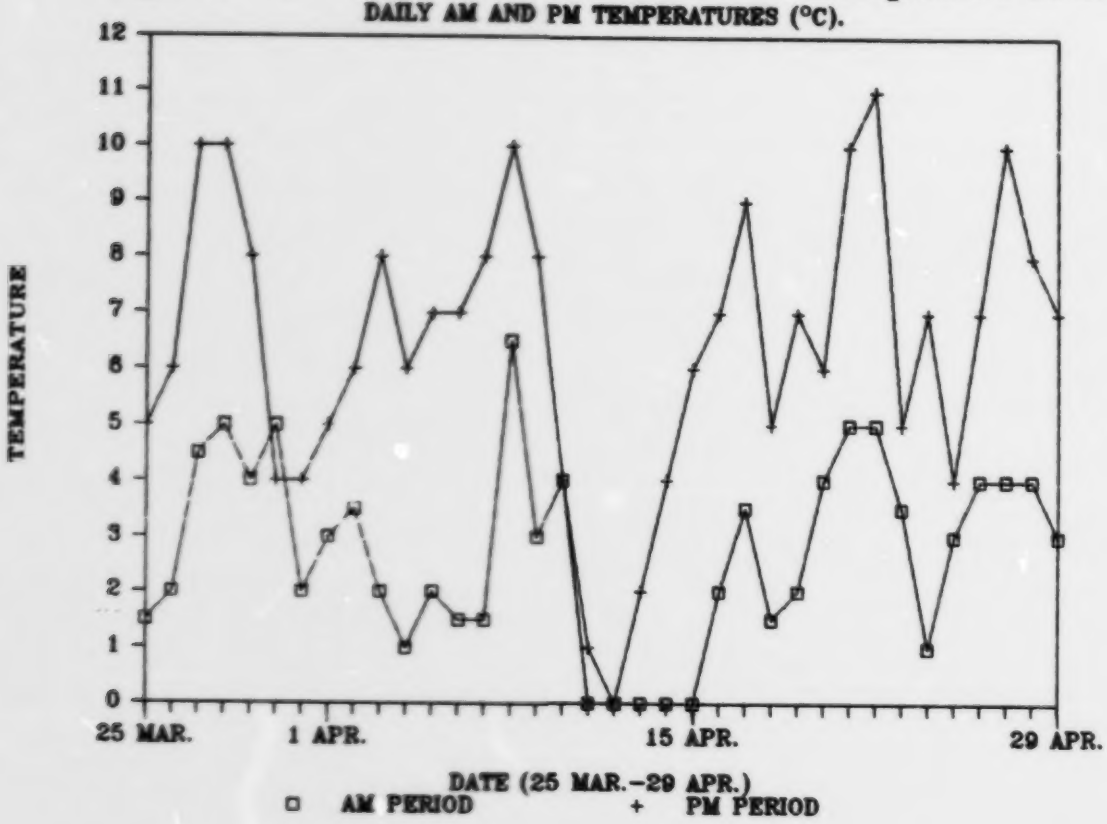


Fig.5.5 Crowsnest R. water temperatures.



Regular water temperature monitoring was not undertaken on the Oldman River or Castle River, however, spot measurements were taken by the field crew during sampling events (Appendix A, Table A2). Comparing these values to those obtained on the Crowsnest River during a similar time period indicated that the thermal regimes in the three systems were fairly similar.

Turbidity levels were variable throughout the course of the survey being largely dependent upon weather-related events (i.e., degree of snow melt, local precipitation). Levels were relatively low during cold weather, low flow periods (i.e., 11-13 April) and were relatively high during warm weather, high flow periods (e.g., 22-24 April). In the Crowsnest River, turbidity levels were noticeably higher below Connelly and Todd creeks due to the high suspended sediment loads in these systems; this was particularly evident during active snow melt periods or following local precipitation events.

5.2 FISH DISTRIBUTION AND RELATIVE ABUNDANCE

5.2.1 CROWSNEST RIVER

Three sportfish species were represented in the April 1986 electrofishing catch in the Crowsnest River: rainbow trout, brown trout, and mountain whitefish. One bull trout was observed during the survey. As indicated by electrofishing CPUE values the dominant species in the system was mountain whitefish (Table 5.1). Mountain whitefish densities were highest in the upper sample sections (ES3A, ES3; Figure 5.10). Rainbow trout also exhibited a widespread distribution, however, they were most abundant in the upper study sections. Brown trout were captured in all sample sections but their distribution was localized. Figures 5.6 and 5.7 illustrate seasonal trends in CPUE for the various species and sample sections. Other species encountered in the catch included longnose and white suckers; these species occurred sporadically but were locally abundant (Appendix C, Table C1).

5.2.2 OLDMAN RIVER

Three sportfish species were encountered in the electrofishing catch (sections ES1, ES1A, ES2A, ES2; Figure 5.11) in the north fork of the Oldman River during the April 1986 survey. Represented in the catch were rainbow trout, mountain whitefish, and bull trout. As indicated by electrofishing CPUE values, mountain whitefish were the dominant sportfish species in the north fork section (Table 5.2). Rainbow trout were

Table 5.1 Summary of boat electrofishing catch and CPUE (catch/km and catch/min) for major sportfish species in the Crowsnest River, April 1986.

Section	Location (km)	Date	Sample Effort (min)	Sample Distance (km)	Rainbow trout			Brown trout			Mountain whitefish		
					No. Caught	Catch/ km	Catch/ min	No. Caught	Catch/ km	Catch/ min	No. Caught	Catch/ km	Catch/ min
PS1	4.1-0.0	17 Apr.	36.4	4.1	15	3.66	0.41	5	1.22	0.14	358	87.32	9.84
Stop #1	4.1-3.3		9.2	0.8	4	5.00	0.43	2	2.50	0.22	11(138)		
#2	3.3-2.1		8.8	1.2	5	4.17	0.57	1	0.83	0.12	13(140)		
#3	2.1-0.0		18.4	2.1	6	2.86	0.33	2	0.95	0.11	29(328)		
	4.1-0.0	23 Apr.	36.1	4.1	8	1.95	0.22	1	0.24	0.03	270	65.85	7.48
PS2	9.1-4.1	18 Apr.	47.8	5.0	26	5.20	0.54	7	1.40	0.15	318	63.60	6.65
Stop #1	9.1-8.3		7.6	0.8	5	6.25	0.66	1	1.25	0.13	27(70)		
#2	8.3-7.3		9.7	1.0	7	7.00	0.72				24(180)		
#3	7.3-6.2		11.2	1.1	5	4.54	0.45				25(70)		
#4	6.2-4.8		11.7	1.4	7	5.00	0.60	4	2.86	0.34	18(75)		
#5	4.8-4.1		7.6	0.7	2	2.86	0.26	2	2.86	0.26	9(35)		
	9.1-4.1	23 Apr.	39.1	5.0	7	1.40	0.18	1	0.20	0.03	277	55.40	7.08
Stop #1	9.1-6.6		19.9	2.5	1	0.40	0.05	0			27(200)		
#2	6.6-4.1		19.2	2.5	6	2.40	0.31	1	0.40	0.05	28(205)		
PS3A	13.0-9.1	24 Apr.	30.3	3.5	20	5.71	0.66	2	0.57	0.07	430	122.86	14.19
Stop #1	12.6-11.5		9.3	1.1	4	3.64	0.43						
#2	11.5-11.0		4.6	0.5	2	4.00	0.44	2	4.00	0.44			
#3	11.0-10.0		11.2	1.0	13	13.00	1.16						
#4	10.0-9.1		5.2	0.9	1	1.11	0.19						
	13.0-9.1	25 Apr.	42.8	3.5	23	6.57	0.54	0			434	124.00	10.19
Stop #1	12.6-11.5		13.4	1.1	9	8.18	0.67				144		
#2	11.5-11.0		9.0	0.5	11	22.00	1.22				175		
#3	11.0-9.1		20.2	1.9	3	1.58	0.15	0			115		
PS3	13.0-12.6	9 Apr.	13.8	1.2	10	8.33	0.72	2	1.67	0.14	339	282.50	24.56
Stop #1	13.0-13.7		1.3	0.1	5	50.00	3.85				12(30)		
#2	13.7-12.6		12.5	1.1	5	4.54	0.40	2	1.82	0.16	82(500)		
	14.2-12.6	24 Apr.	29.3	1.6	10	6.25	0.35				152	95.00	5.37
Stop #1	14.2-13.0		4.4	0.4	3	7.50	0.68				46		
#2	13.0-12.6		23.9	1.2	7	5.83	0.29				106		
	13.0-12.6	25 Apr.	13.4	1.2	5	4.17	0.37	1	0.83	0.08	121	100.83	9.03
Combined													
PS1	4.1-0.0	17 & 23 Apr.	72.5	8.2	23	2.80	0.31	6	0.73	0.08	628	76.[illegible]	8.66
PS2	9.1-4.1	18 & 23 Apr.	86.9	10.0	33	3.30	0.37	8	0.80	0.09	595	59.50	6.85
PS3A	13.0-9.1	24 & 25 Apr.	72.9	7.0	43	6.14	0.58	2	0.28	0.03	864	123.43	11.85
PS3	14.2-12.6	24 & 25 Apr.	55.5	4.0	25	6.25	0.45	3	0.75	0.05	612	153.00	11.03
All	14.2-0.0	9-25 Apr.	287.8	29.2	124	4.24		19	0.65		2809	92.43	9.38

Figure 5.6. Comparison of seasonal CPUE values for rainbow trout and brown trout. Crowsnest River, August 1985–April 1986.

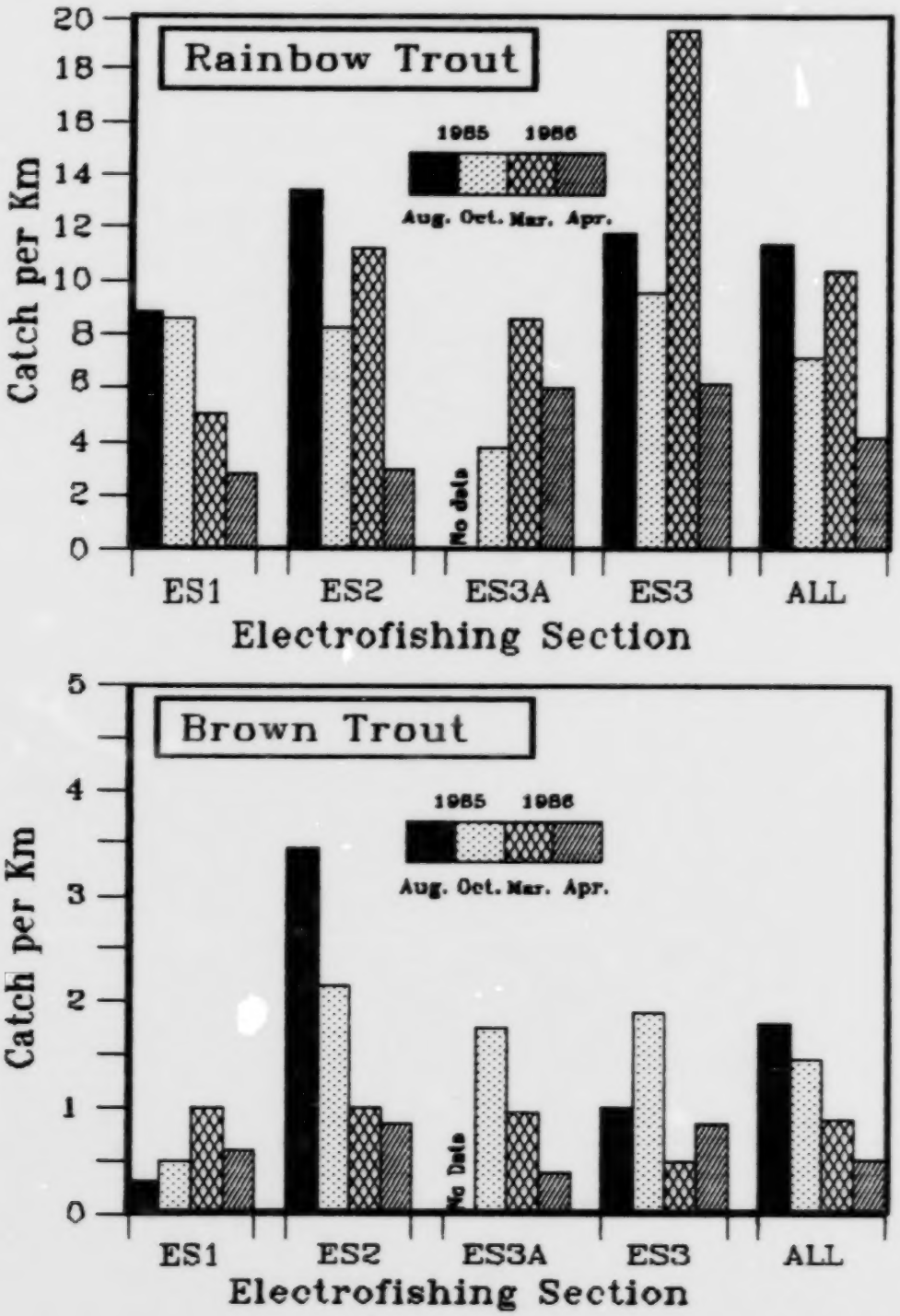


Figure 5.7. Comparison of seasonal CPUE values for mountain whitefish, Crowsnest River, August 1985–April 1986.

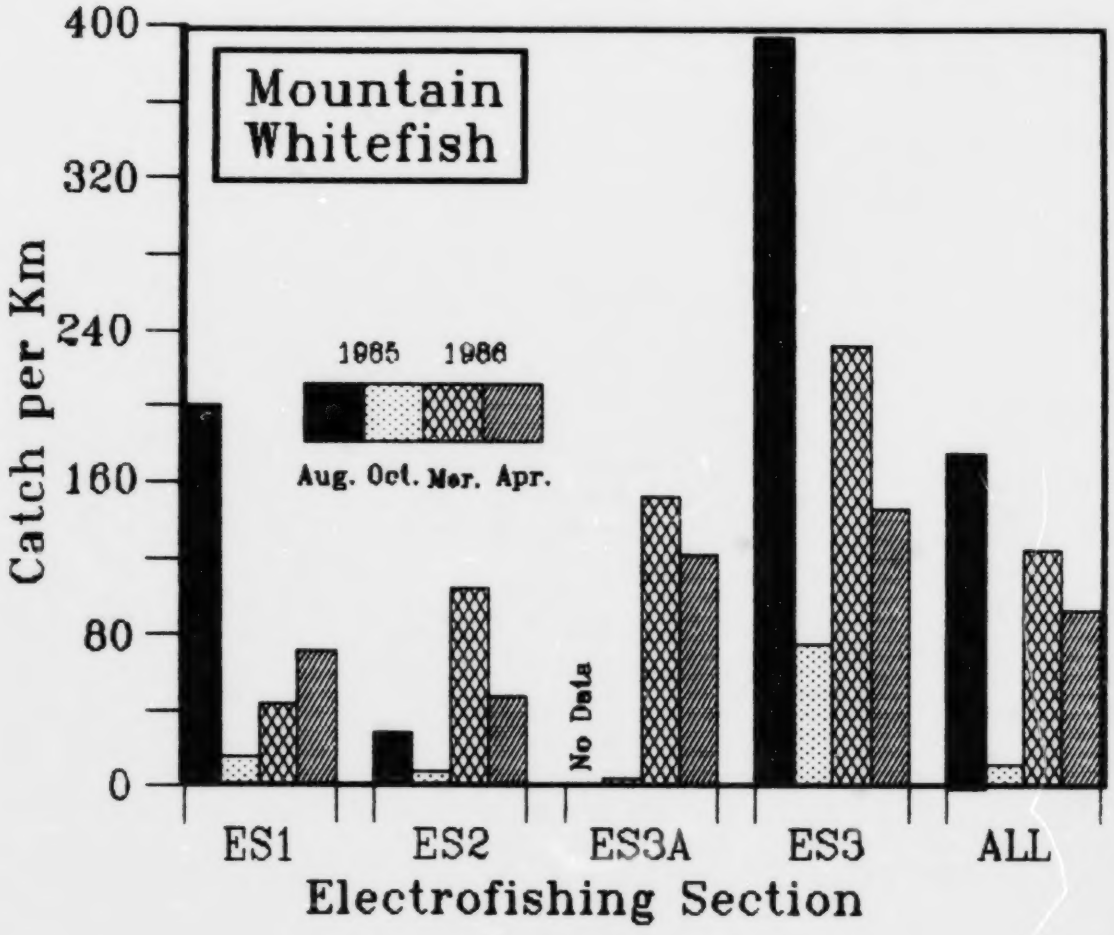


Table 5.2 Summary of boat electrofishing catch and CPUE (catch/km and catch/min) for major sportfish species in the Oldman River, April 1986.

Section	Location (km)	Date	Sample Effort (min)	Sample Distance (km)	Rainbow trout			Brown trout			Mountain whitefish		
					No. Caught	Catch/ km	Catch/ min	No. Caught	Catch/ km	Catch/ min	No. Caught	Catch/ km	Catch/ min
ES1A	**331.5-330.5**	**17 Apr.**	**9.2**	**1.0**	**0**						**123**	**123.00**	**13.37**
	331.5-316.0	**20-21 Apr.**	**128.3**	**15.5**	**4**	**0.26**	**0.03**	**3**	**0.19**	**0.02**	**652**	**42.06**	**5.08**
Stop #1	331.5-330.4	20 Apr.	6.8	1.1	1	0.91	0.15	1	0.91	0.15	80		
#2	330.4-329.0		10.4	1.4	0						77		
#3	329.0-327.0		10.7	2.0	0						86		
#4	327.0-326.2	21 Apr.	5.2	0.8							39		
#5	326.2-325.0		13.3	1.2	1	0.83	0.08				45		
#6	325.0-322.5		17.4	2.5	0						97		
#7	322.5-320.9		29.8	1.6	2	1.25	0.07				87		
#8	320.9-316.0		34.7	4.9	0			2	0.41	0.06	141		
ES1	**339.0-331.6**	**20 Apr.**	**44.9**	**7.4**	**2**	**0.27**	**0.04**				**45**	**6.08**	**1.00**
Stop #1	339.0-335.8		23.3	3.2	2	0.62	0.09				12	3.75	0.52
#2	335.8-333.2		11.4	2.6	0						17	6.54	1.49
#3	333.2-331.6		10.2	1.6							16	10.00	1.57
ES2A	**345.0-339.0**		**40.2**	**6.0**	**1**	**0.17**	**0.02**				**17**	**2.83**	**0.42**
Stop #1	345.0-340.9		25.5	4.1	1	0.24	0.04				12	2.93	0.47
#2	340.9-339.0		14.7	1.9	0						5	2.63	0.34
ES2	**351.4-345.0**	**19 Apr.**	**71.8**	**6.4**	**7**	**1.09**	**0.10**				**33**	**5.16**	**0.46**
Stop #1	351.4-348.8		23.2	2.6	4	1.54	0.17				7	2.69	0.30
#2	348.8-345.0		48.6	3.8	3	0.79	0.06				26	6.84	0.53
Combined				36.3	14	0.39					870	23.97	

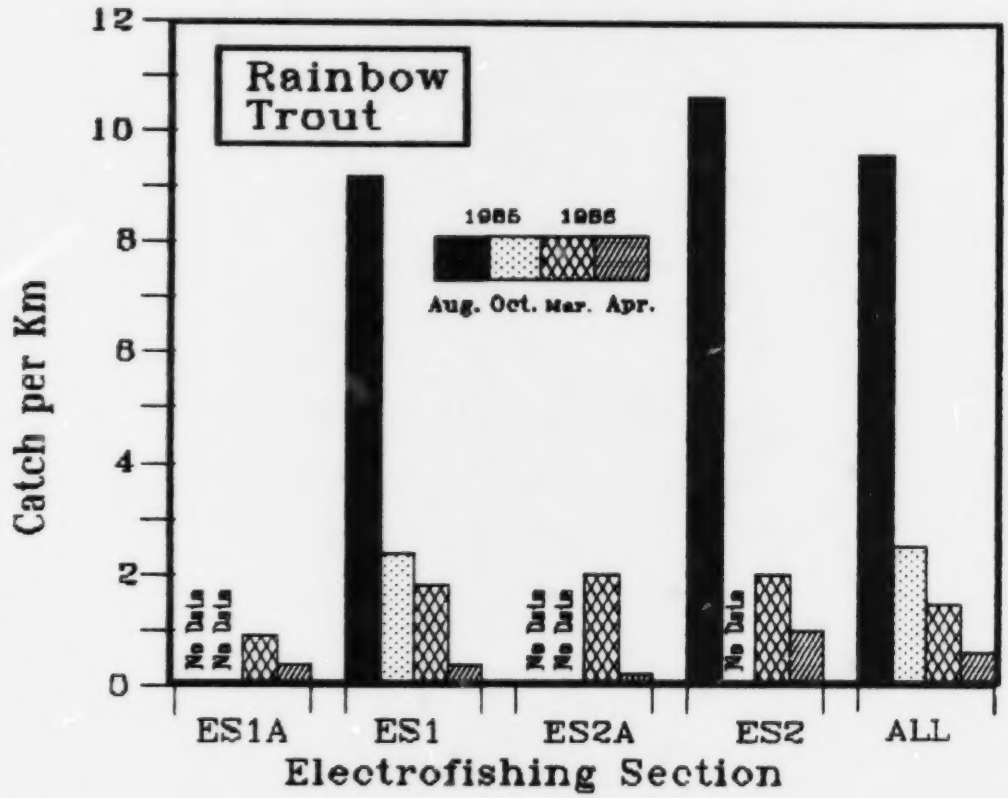
distributed sporadically and in low numbers. Very few bull trout were represented in the catch. The data suggests either the presence of a small resident population or straying from populations outside the immediate study area (e.g., upper Oldman River) (Appendix C, Table C1). Seasonal trends in CPUE for rainbow trout and mountain whitefish are presented in Figure 5.8. In general, the CPUE data suggests that rainbow trout were less abundant in spring 1986 than in August 1985. The only other large species encountered in the spring survey was longnose sucker. This species exhibited a localized distribution (Appendix C, Table C1).

The main branch of the Oldman River (below confluence with Crowsnest River) supported rainbow trout, mountain whitefish, bull trout, and brown trout. CPUE data for section ES1A (Crowsnest River confluence to damsite) indicates that rainbow trout were uncommon in this portion of the river during the April 1986 survey (Table 5.2). In contrast, mountain whitefish were abundant. Brown trout and bull trout exhibited a localized distribution in this reach. Other species encountered in the catch included longnose sucker and white sucker (Appendix C, Table C1).

5.2.3 CASTLE RIVER

Three sportfish species were encountered in the Castle River, including rainbow trout, mountain whitefish, and bull trout. Mountain whitefish exhibited the highest relative abundance followed by rainbow trout and bull trout (Table 5.3). CPUE values obtained were highest in the lower Castle River (section ES1; Figure 5.12) for each of the species, likely due to the proximity of the Oldman River (i.e., source of migrants into the Castle River). The seasonal variation in the relative abundance of rainbow trout and mountain whitefish in sample sections in the Castle River is illustrated in Figure 5.9. CPUE values obtained in April 1986 were somewhat higher than those recorded in the October 1985 and March 1986 surveys, particularly in the lower Castle River (section ES1). This may indicate a recent in-movement of fish from the Oldman River had occurred (i.e., for spawning and/or feeding purposes). A total of seven bull trout were captured in the Castle River; all were taken in the lower sample section (i.e., ES1) (Table 5.3). Other species captured included longnose suckers and white suckers; both exhibited a sporadic distribution and were more prevalent in the lower sample section (ES1) (Appendix C, Table C1).

Figure 5.8. Comparison of seasonal CPUE values for rainbow trout and mountain whitefish. Oldman River, August 1985–April 1986.



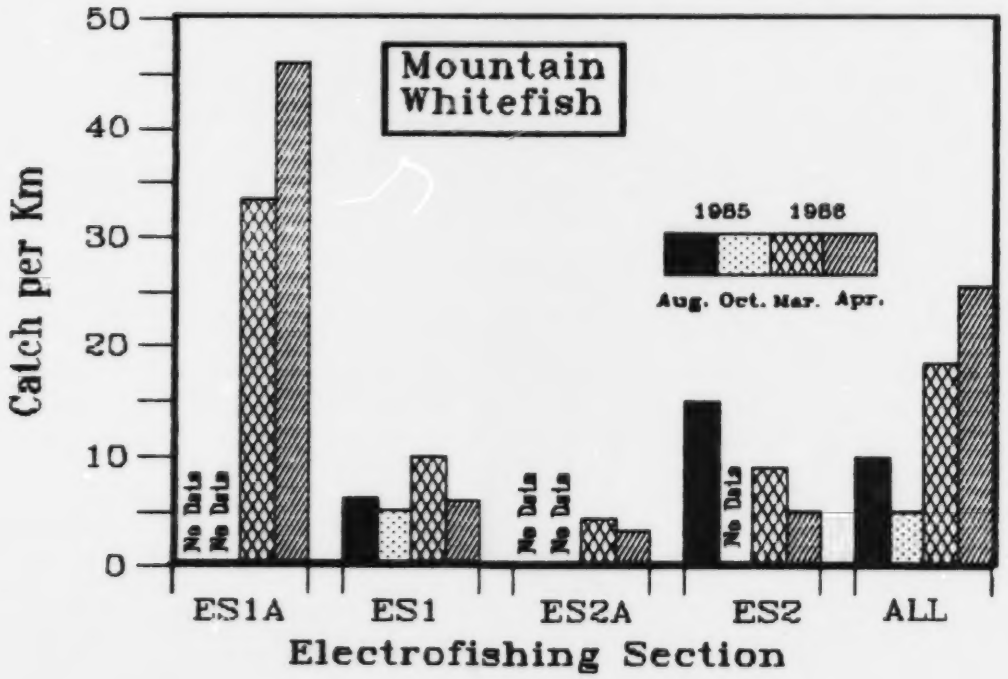
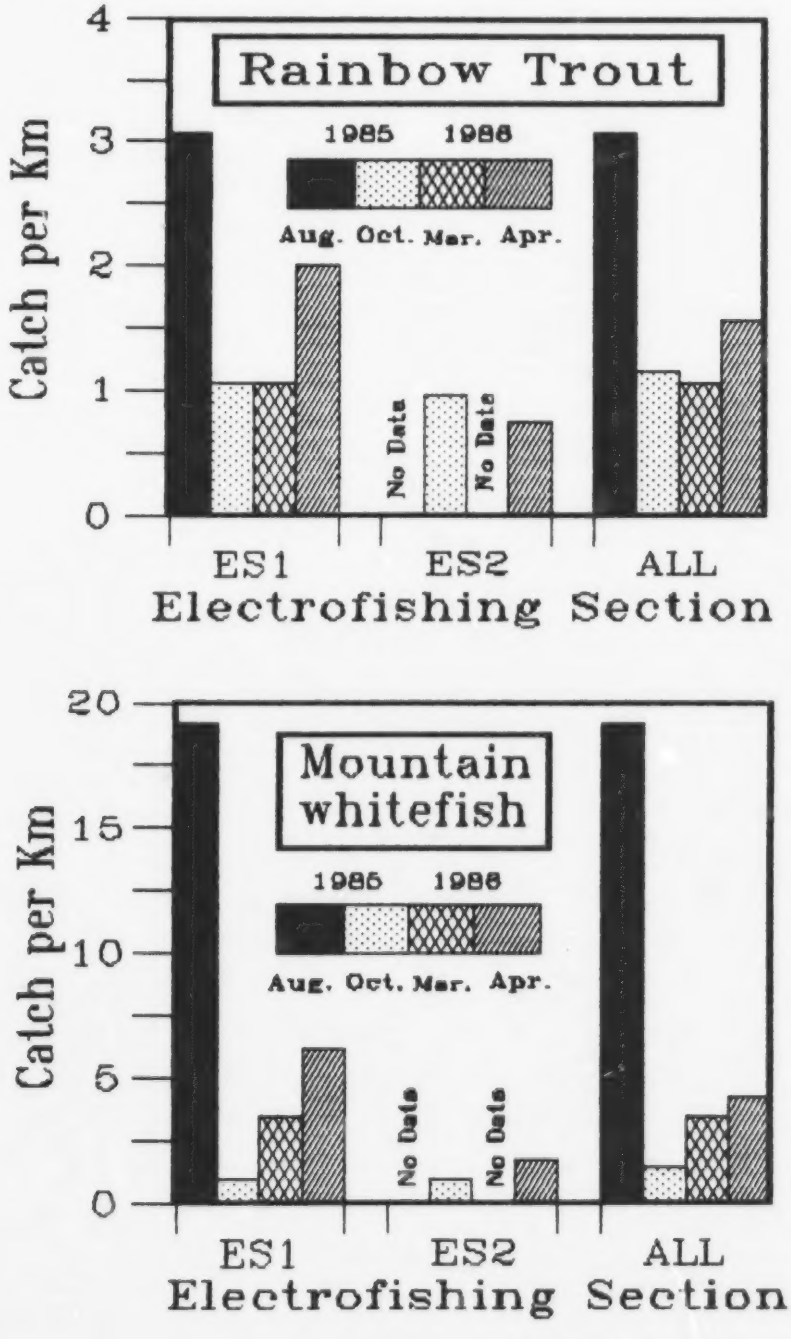


Table 5.3 Summary of boat electrofishing catch and CPUE (catch/km and catch/min) for major sportfish species in the Castle River, April 1986.

Section	Location (km)	Date	Sample Effort (min)	Sample Distance (km)	Rainbow trout			Bull trout			Mountain whitefish		
					No. Caught	Catch/ km	Catch/ min	No. Caught	Catch/ km	Catch/ min	No. Caught	Catch/ km	Catch/ min
ES1	**13.3-0.0**	**15 Apr.**	**146.6**	**13.3**	**27**	**2.03**	**0.18**	**7**	**0.53**	**0.05**	**78**	**5.86**	**0.53**
Stop #1	13.3-12.1		26.1	1.2	2	1.67	0.08				17	14.17	0.65
#2	12.1-9.8		25.2	2.3	6	2.61	0.24	1	0.43	0.04	7	3.04	0.28
#3	9.8-7.5		18.7	2.3	6	2.61	0.32	2	0.87	0.11	7	3.04	0.37
#4	7.5-5.2		24.0	2.3	7	3.04	0.29				6	2.61	0.25
#5	5.2-2.5		28.2	2.7	3	1.11	0.11	3	1.11	0.11	13	4.82	0.46
#6	2.5-0.0		24.4	2.5	3	1.20	0.12	1	0.40	0.04	28	11.20	1.15
ES2	**24.0-14.9**	**14 Apr.**	**90.1**	**9.1**	**7**	**0.77**	**0.08**				**17**	**1.86**	**0.19**
Stop #1	24.0-22.2		16.0	1.8	2	1.11	0.12				6	3.33	0.38
#2	22.2-19.9		29.4	2.3	1	0.44	0.03				3	1.30	0.10
#3	19.9-14.9		44.7	5.0	4	0.80	0.09				8	1.60	0.18
Combined				22.4	34	1.51					95	4.24	

Figure 5.9. Comparison of seasonal CPUE values for rainbow trout and mountain whitefish. Castle River, August 1985–April 1986.



5.3 RAINBOW TROUT SPAWNING USE

5.3.1 CROWSNEST RIVER

5.3.1.1 Distribution of Spawning

The distribution of rainbow trout spawning in the Crowsnest River was determined through visual redd surveys and boat-electrofishing surveys. Visual redd surveys (floating and ground access) were effective during periods of low to moderate water clarity. Suitable conditions occurred for a brief period in mid-April in response to a return to colder weather and reduced streamflow (Figure 5.1). During periods of higher turbidity and streamflow it was necessary to rely on indirect spawning data (i.e., presence or absence of adults in spawning or immediate post-spawning condition). Rainbow trout redds were identified and measured during the period 10-13 April; additional surveys, involving only visual enumeration, were conducted on 18 and 20 April. Boat electrofishing surveys were conducted periodically over the 8-25 April period.

A total of 34 rainbow trout redds were located during the 1986 survey. Although they were distributed from km 8.9 and km 15.2, the majority (n=15) were situated within a 2.1 km reach (i.e., km 10.3 to 12.4) (Figure 5.10). All but two of the redds were positioned upstream of the proposed reservoir FSL (1118.6 m). Based on present data it appears that the lower Crowsnest River (i.e., sections ES1 and ES2) supports limited rainbow trout spawning use. CPUE data generated during boat electrofishing surveys tends to support this contention (Table 5.1). Overall CPUE values for the upper sample sections (ES3 and ES3A, km 14.2 - km 9.1) were 6.25 and 6.14 fish/km, respectively. In contrast, CPUE values derived for the lower sample sections (ES1 and ES2, km 0-9.1) were noticeably lower (2.8 and 3.30 fish/km, respectively). Differences in values derived during the latter stages (i.e., 23-25 April) of the spawning run were even more pronounced (i.e., ES1 - 1.95 fish/km; ES2 - 1.40 fish/km; ES3A - 6.57 fish/km; ES3 - 6.25 fish/km). The majority of adults in ripe and recently spent condition were captured in sections ES3 and ES3A (particularly the latter) suggesting that these reaches were of relatively greater spawning importance.

Greater use of the upper stream reaches likely reflects the availability of suitable spawning habitat. Section ES3A, in particular, provides an abundance of preferred habitat types (i.e., shallow riffle and run); RF and R3 habitat types comprise approximately 78% of the total surface area within this section. Downstream reaches exhibited noticeable substrate limitations (overly coarse substrate in ES2; excessive sediment

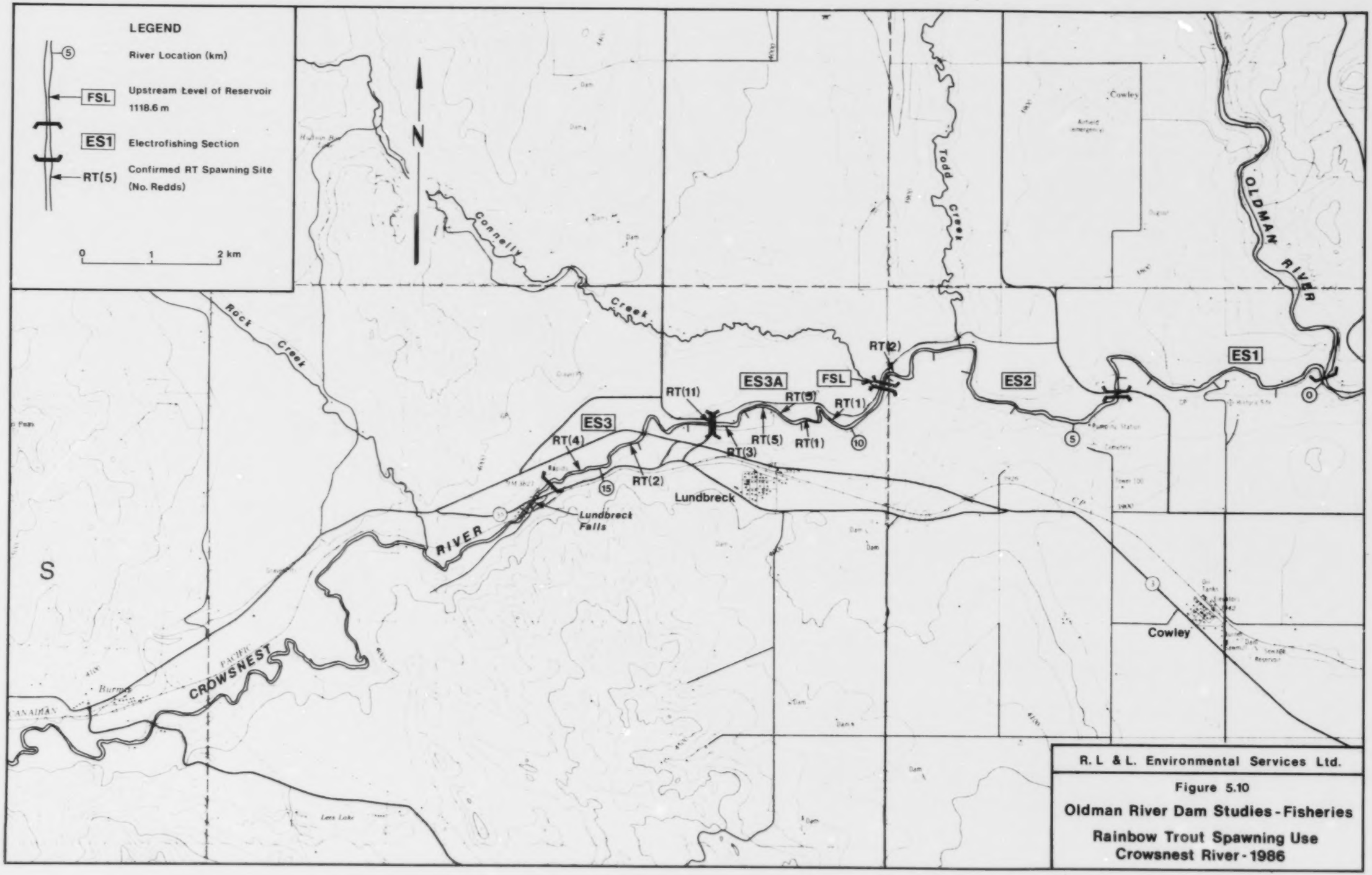


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Figure 5.10

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Rainbow Trout Spawning Use Crowsnest River - 1986

deposition in ES1). The periodic injection of sediment into the system from Connelly and Todd creeks may contribute to the limited spawning use of lower reaches. The higher availability of y-o-y rearing habitat and relatively limited presence of major adult feeding/holding areas (R1, P1 habitat types) in the upper section (particularly in ES3A) also may be important in the spawning area selection process (i.e., pre-selection of areas suitable for subsequent rearing). The boat electrofishing results obtained in the 1985 spring study (IEC Beak 1985) tend to support the spawning distribution data collected in the present study. The previous investigators recorded concentrations of adult rainbow trout in sections identified as being of high spawning importance in the present study.

5.3.1.2 Chronology and Water Temperature Regime

Of the 34 redds enumerated, 19 were observed during the period 10-13 April. Daily water temperatures at this time ranged between 0-4°C. The relatively low temperatures were in response to the return of cold weather conditions. Water temperatures during the preceding days (i.e., 8-9 April), the probable spawning period, ranged between 5-10°C. An additional 15 redds were located during surveys on 18 and 20 April; water temperatures during the days prior to the survey ranged between 0 and 8°C (i.e., substantially higher values than recorded in the previous cold weather period). Based on electrofishing results (i.e., presence of numerous adults in ripe condition), it is apparent that spawning activities were still in progress at the completion of the field studies.

5.3.1.3 Description of Spawning Sites

The majority of redds were situated in shallow riffle (RF) and shallow-run (R3) habitat types. Most were situated at or immediately below the velocity break between R3 and RF habitat types. The gradient (i.e., clinometer reading from above to below site) at spawning sites ranged between 0.75 and 1.00%. Redds were generally located either peripheral to deeper and faster habitat types (i.e., RA, R2) or on the inside curvature of river bends. These situations presumably provided a favorable combination of depth, velocity, and substrate conditions. In terms of channel placement, redds were often situated near the bank (as close as 3 m), although in some cases they were located up to one-third of the channel width from the bank (up to 10 m from bank). Instream cover at and adjacent to the redds was generally negligible. Banks adjacent to the redds were characteristically low-lying deposition bars vegetated by grass or consisting of sand or gravel/cobble materials; as such they provided no noticeable instream cover benefits.

It is of interest to note some of the dissimilarities between rainbow trout spawning sites and those described for brown trout by O'Neil and Hildebrand (1986). Brown trout apparently preferred outside curvature channel placement with a strong bank cover association.

The dimensions and the depth/velocity/substrate characteristics at 16 rainbow trout redds are provided in Table 5.4. Water depth in the vicinity of redds generally ranged between 20 cm and 50 cm. Mean column velocities at redd sites ranged between 51.3 $\pm$16.2 to 100.3 $\pm$ 14.3 $cm \cdot s^{-1}$. Nose velocities (10 cm from bottom) at redd sites varied from 54.8 $\pm$ 11.1 to 85.4 $\pm$ 14.7 $cm \cdot s^{-1}$. Substrate characterization was based on an assessment of disturbed materials within redds. Values were determined (after Bain et al 1985) for substrate surface coarseness (substrate class) and substrate heterogeneity (Standard Deviation of $\bar{x}$ Substrate Class). Spawning substrates were dominated by materials in substrate classes 4, 5, and 6; these classes include "medium gravel" (0.1-1.6 cm), "coarse gravel" (1.6-3.2 cm), and "very coarse gravel" (3.2-6.4 cm). The relatively low standard deviation values obtained indicates the presence of relatively homogeneous substrate (i.e., sorted gravels primarily in the Class 4, 5, and 6 categories; general absence of large and small fractions). Substrate compaction ranged from low to moderate; degree of embeddeddness was generally within the 0-25% range. Extent of algal cover on undisturbed substrates in the vicinity of redds generally ranged from 75-100%; the algal density was generally rated as low to moderate.

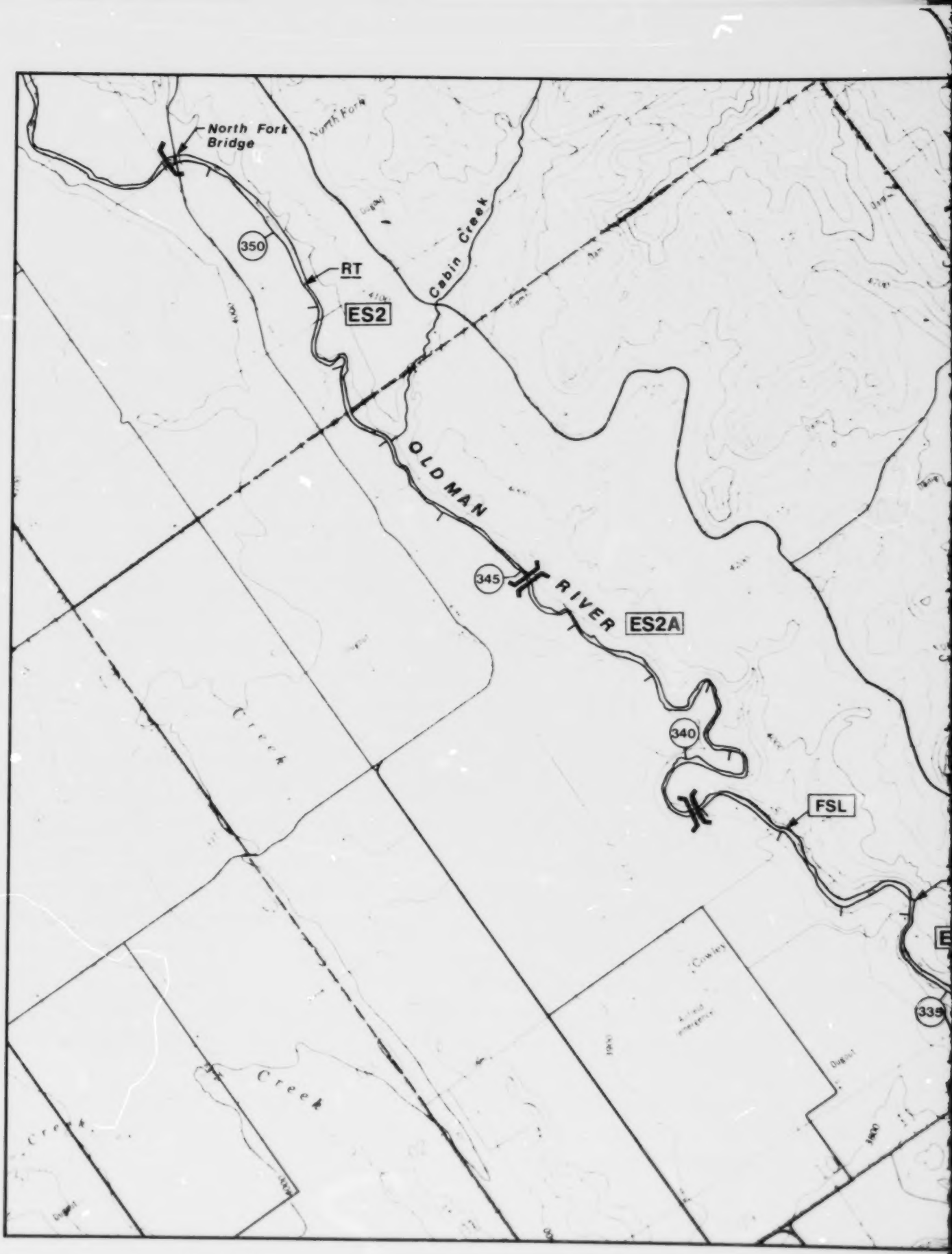
5.3.2 OLDMAN RIVER

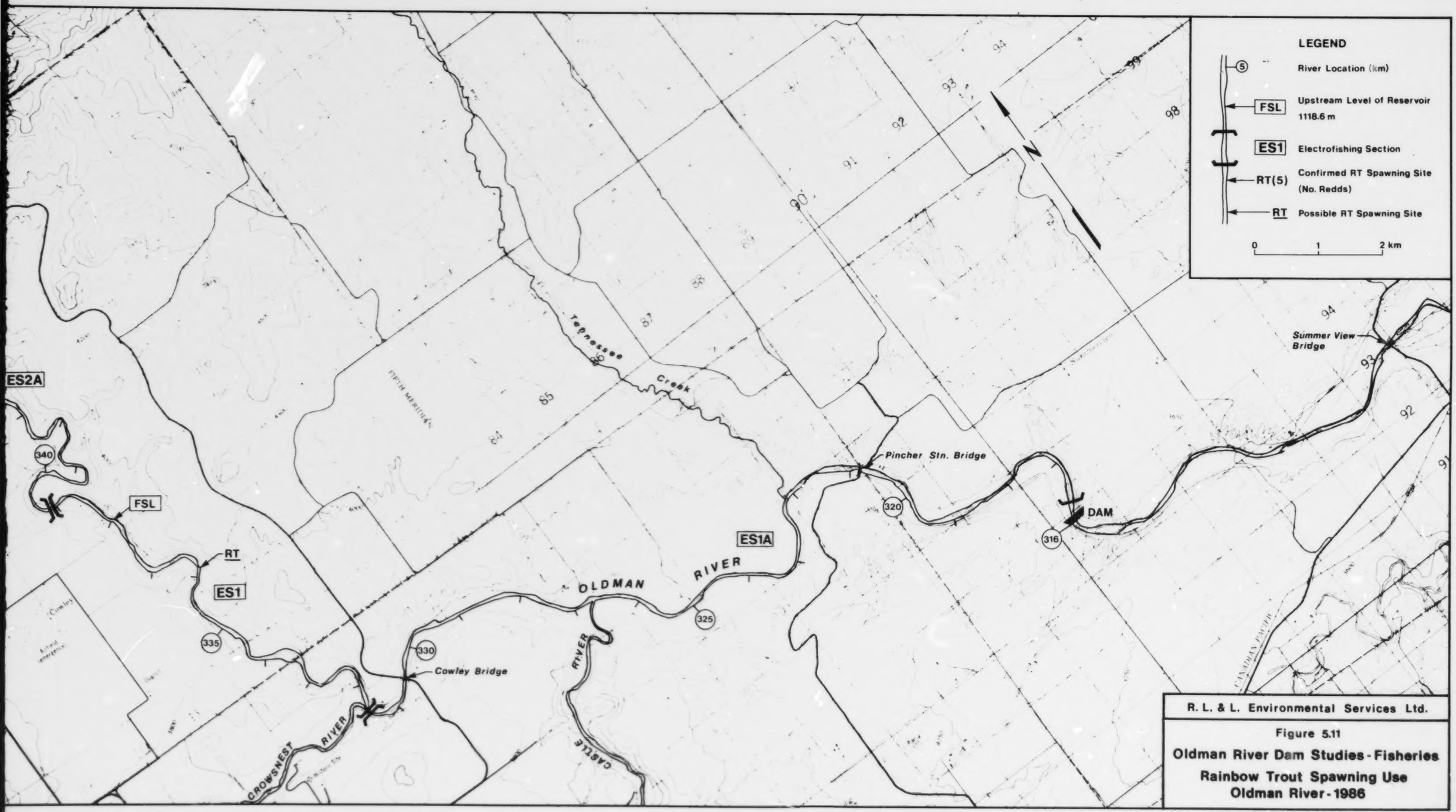
Electrofishing surveys were conducted on the north fork of the Oldman River on 19 and 20 April to determine the distribution and extent of rainbow trout adults in spawning condition. As indicated by CPUE data (Table 5.2), rainbow trout were present in low numbers during the survey period. This suggests low overall spawning use of the north fork section (within the surveyed portion). However, based on the presence of female rainbow trout in pre-spawning condition three possible spawning sites were designated (Figure 5.11). A large (545 mm), ripe female was captured at km 351.1 (below North Fork Bridge) on 19 April; this individual appeared to be in the process of spawning (i.e., portion of eggs already released). Suitable riffle spawning habitat was noted in the vicinity. This individual was considerably larger than rainbow trout generally encountered in the reach (i.e., based on previous survey results). Gravid females were also taken at km 349.3 (N=1) and km 336.1 (N=1); localized areas suitable for spawning (i.e., gravel/cobble sites at head of riffles) were noted in the vicinity of the latter site.

Table 5.4 Physical characteristics of rainbow trout redds (N=16) in the Crowsnest River, April 1986.

Location (km)	Survey Date	Dimensions		Depth (cm)	Velocity ($cm \cdot s^{-1}$)				Substrate Class
		Length x width (m)	Area (m^2)	$\bar{x} \pm$ S.D.	Nose[a] $\bar{x} \pm$ S.D.	0.6 d $\bar{x} \pm$ S.D.	Surface $\bar{x} \pm$ S.D.	Column $\bar{x} \pm$ S.D.	$\bar{x} \pm$ S.D.
12.4	10 Apr.	1.0 x 0.50	0.50	4.6 ± 3.1	66.4 ± 5.7	86.2 ± 8.1	72.4 ± 5.5	75.0 ± 10.5	5.6 ± 1.0
	10 Apr.	1.1 x 0.62	0.68	31.4 ± 3.0	62.6 ± 5.1	76.6 ± 4.4	83.0 ± 4.3	74.1 ± 9.8	5.6 ± 0.8
11.8	10 Apr.	1.4 x 0.60	0.84	35.4 ± 4.6	69.0 ± 15.1	81.8 ± 7.1	79.0 ± 5.0	76.6 ± 10.9	5.4 ± 1.1
	10 Apr.	1.7 x 0.75	1.28	34.4 ± 5.2	63.2 ± 7.7	81.0 ± 4.6	76.4 ± 4.0	73.5 ± 9.4	5.1 ± 1.1
	10 Apr.	1.0 x 1.00	1.00	37.6 ± 7.8	61.4 ± 20.9	74.8 ± 12.6	76.4 ± 14.4	70.9 ± 16.7	5.8 ± 0.7
	10 Apr.	1.4 x 0.50	0.70	32.6 ± 4.1	69.0 ± 8.5	70.4 ± 7.9	67.6 ± 8.7	69.0 ± 7.9	5.0 ± 1.1
11.4	10 Apr.	1.6 x 0.50	0.80	32.8 ± 3.4	54.8 ± 11.1	66.4 ± 7.5	71.2 ± 8.5	51.3 ± 16.2	5.0 ± 0.8
	10 Apr.	1.4 x 0.65	0.91	31.4 ± 3.5	65.6 ± 7.5	73.8 ± 9.1	74.6 ± 8.2	71.3 ± 8.8	5.5 ± 1.0
	10 Apr.	1.1 x 0.8	0.88	31.0 ± 5.4	59.6 ± 19.8	73.8 ± 7.8	75.8 ± 7.5	69.7 ± 14.2	5.0 ± 0.8
	10 Apr.	2.3 x 0.85	1.96	33.6 ± 5.4	62.0 ± 13.5	72.0 ± 9.9	72.2 ± 8.4	68.7 ± 11.2	5.3 ± 0.7
10.9	10 Apr.	1.4 x 0.60	0.84	43.2 ± 4.4	68.0 ± 4.7	93.4 ± 6.3	96.2 ± 4.5	85.9 ± 14.0	5.5 ± 0.8
10.3	10 Apr.	2.7 x 1.00	2.70	28.2 ± 7.1	76.4 ± 14.0	91.4 ± 14.6	89.2 ± 8.4	85.7 ± 13.6	5.8 ± 0.7
8.9	11 Apr.	2.7 x 1.10	2.97	38.2 ± 4.3	85.4 ± 14.4	107.4 ± 7.4	108.0 ± 6.4	100.3 ± 14.3	5.8 ± 0.8
	11 Apr.	2.0 x 1.00	2.00	44.8 ± 5.1	-	-	-	-	5.7 ± 0.7
14.2	12 Apr.	1.6 x 0.8	1.28	30.8 ± 4.2	67.0 ± 3.5	72.0 ± 4.6	68.8 ± 8.3	69.3 ± 5.8	4.2 ± 0.9
	12 Apr.	1.4 x 0.6	0.84	31.0 ± 2.4	71.8 ± 4.7	81.0 ± 3.4	76.0 ± 1.7	76.3 ± 5.0	
Combined Mean ± S.D.		1.6 x 0.74	1.19	32.6 ± 8.7	66.8 ± 7.3	80.1 ± 10.8	78.8 ± 11.4	74.5 ± 10.7	5.4 ± 0.5

[a] Nose velocity - 10 cm from bottom.


North Fork Bridge
North Fork
Cabin Creek
350
RT
ES2
OLDMAN
345
RIVER
ES2A
340
FSL
339
Creek
Creek
Creek



R. L. & L. Environmental Services Ltd.

Figure 5.11

Oldman River Dam Studies - Fisheries

Rainbow Trout Spawning Use
Oldman River - 1986

Recorded water temperaturs in the north fork section during the survey period ranged between 6 and 10°C (Appendix A, Table A2).

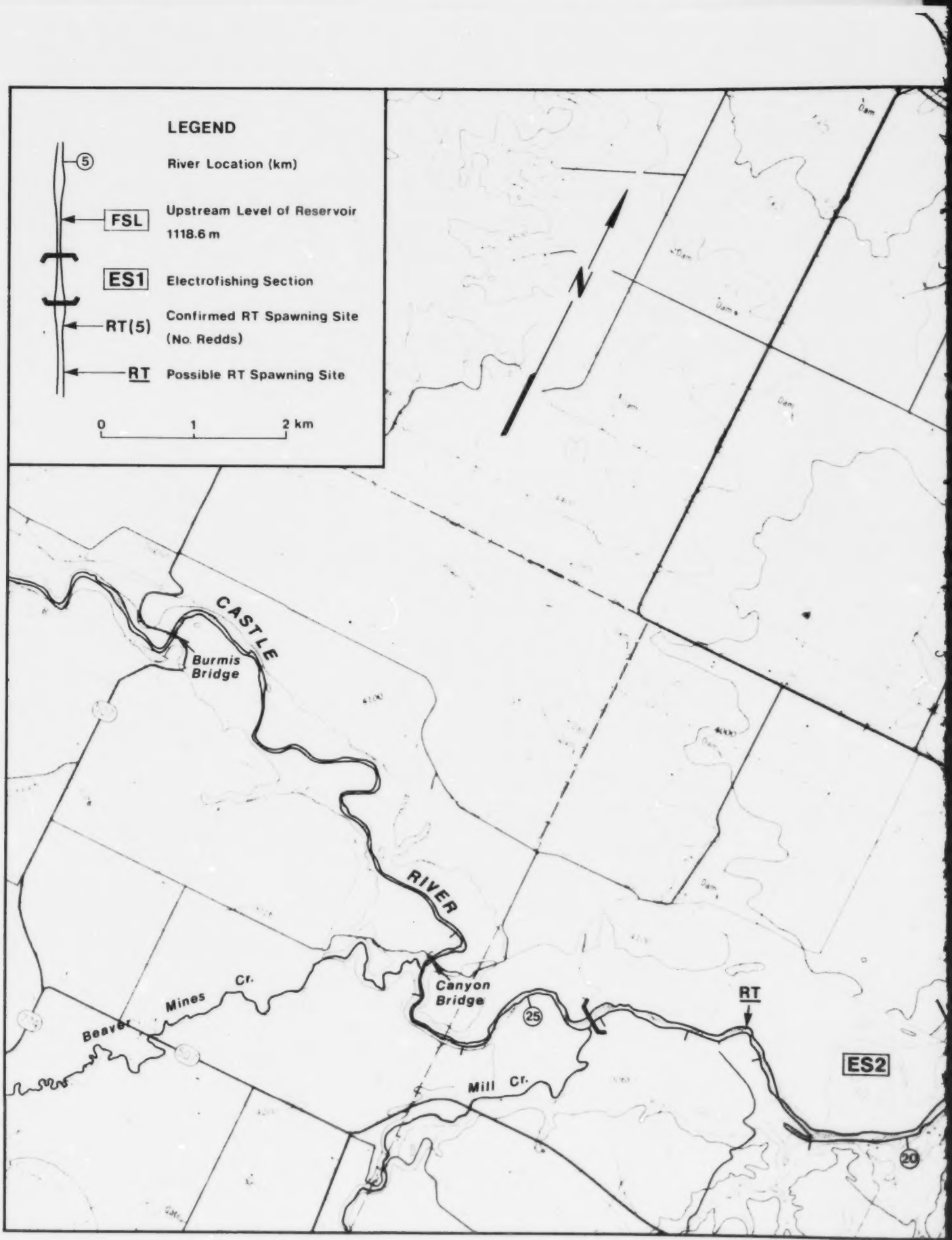
Electrofishing results (Table 5.2) for the main branch of the Oldman River (Crowsnest River confluence to damsite) indicate limited spawning use by rainbow trout. Although a few gravid adults were recorded, there was no definite suggestion of actual spawning use (i.e., absence of ripe or recently spent individuals sampled in close association with suitable spawning habitats).

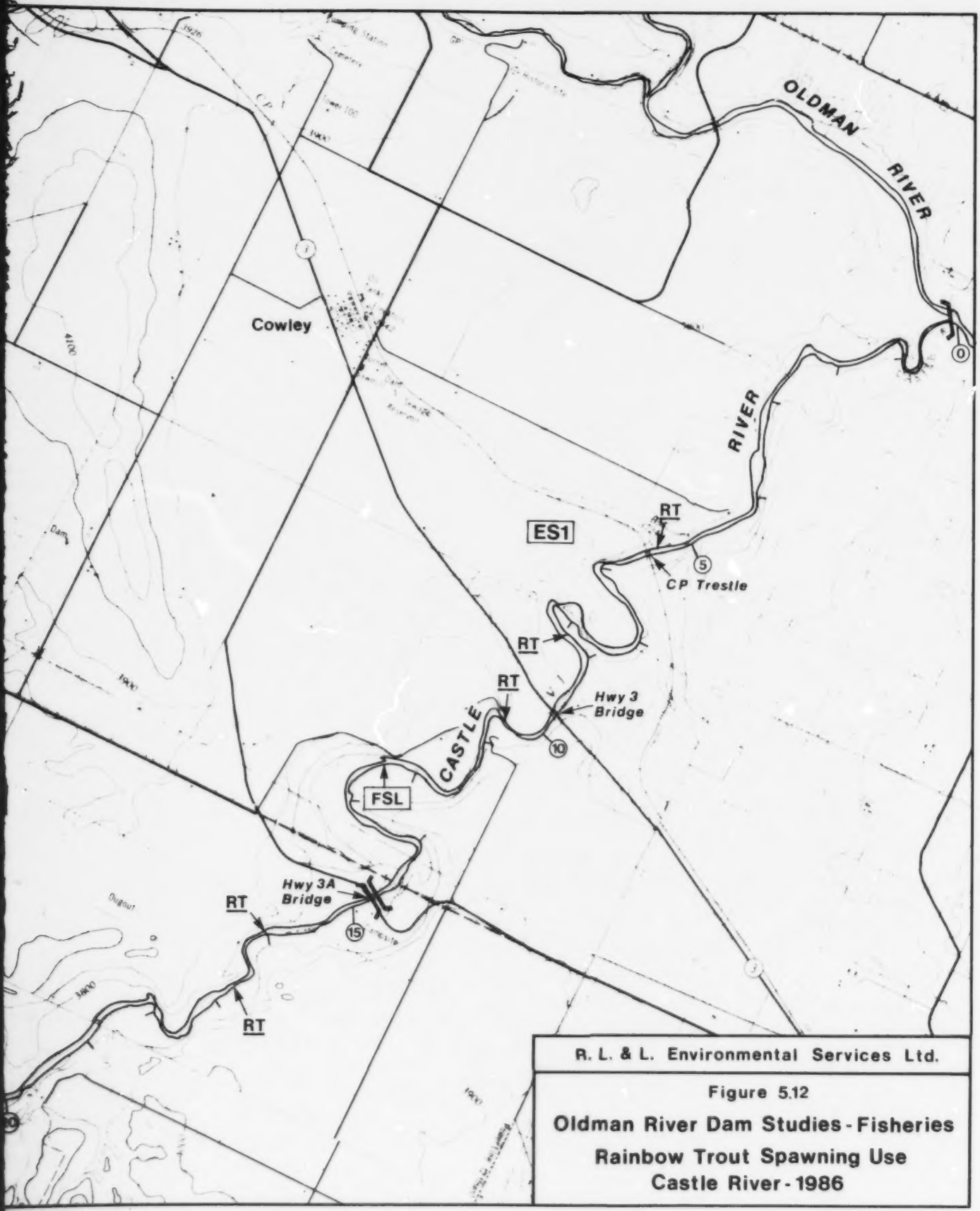
5.3.3 CASTLE RIVER

Electrofishing surveys were conducted on the Castle River on 14 and 15 April to determine the distribution and extent of rainbow trout spawners. Although low numbers of rainbow trout were encountered (Table 5.3), the data suggests the occurrence of several possible spawning sites (Figure 5.12). Gravid female rainbow trout were captured at six locations; in all cases suitable spawning habitat (i.e., preferred depth (velocity/substrate characteristics) was situated nearby. Of interest was the relatively large size of the adults encountered (i.e., up to 472 mm); during previous surveys (O'Neil and Hildebrand 1986) fish of this size were not commonly encountered in the Castle River. Recorded water temperatures during the survey period ranged between 2.5 and 7.0°C (Appendix A, Table A2).

5.4 TAG RECAPTURES AND FISH MOVEMENTS

In the April 1986 survey, 59 tagged sportfish were recaptured; the total included 19 rainbow trout, 33 mountain whitefish, five brown trout, and two bull trout (Table 5.5). Of the rainbow trout recaptured (N=19) 17 were tagged and recaptured in the Crowsnest River. Of the two remaining individuals one was tagged in the Oldman River and recaptured in the Crowsnest River and the other was tagged in the Crowsnest River and recaptured in the Oldman River. The majority (N=11) of the recaptured rainbow trout were tagged during the March 1986 survey although fish tagged in April 1986 and August, September, and October of 1985 were also recaptured. Although the results are variable most (i.e., 7 of 11) of the rainbow trout tagged in March were recaptured at an upstream location in April. One notable exception was a rainbow trout that was released in the lower Crowsnest River on 9 March; this individual was recaptured on 21 April in the Oldman River (Km 322), resulting in a net downstream movement of 9.6 km. This


LEGEND
River Location (km)
FSL
Upstream Level of Reservoir
1118.6 m
ES1
Electrofishing Section
RT(5)
Confirmed RT Spawning Site
(No. Redds)
RT
Possible RT Spawning Site
0
1
2 km
CASTLE
RIVER
Burmis
Bridge
Beaver
Mines
Cr.
Canyon
Bridge
RT
ES2
Mill Cr.
25
20



R. L. & L. Environmental Services Ltd.

Figure 5.12

Oldman River Dam Studies - Fisheries
Rainbow Trout Spawning Use
Castle River - 1986

Table 5.5 Sportfish recaptured in Oldman River Dam Study Area, April 1986 by R.L. & L. Environmental Services Ltd.

Tag No.	Release River	Release Location (km)	Release Date	Release Length (mm)	Recapture River	Recapture Location (km)	Recapture Date	Recapture Length (mm)
				Rainbow Trout				
1446	Crow	12.8	21 Sep./85	376	Crow	3.6	17 Apr./86	447
1602	Crow	8.5	22 Aug./85	355	Crow	13.0	24 Apr./86	368
1646	Crow	6.3	22 Aug./85	473	Crow	5.5	16 Apr./86	465
1742	Crow	4.5	2 Oct./85	366	Crow	4.5	16 Apr./86	371
1823	Crow	4.1	9 Mar./86	342	Crow	2.7	17 Apr./86	346
1832	Crow	7.9	9 Mar./86	320	Crow	10.5	24 Apr./86	321
1838	Crow	7.9	9 Mar./86	358	Crow	5.5	16 Apr./86	360
1847	Crow	6.1	9 Mar./86	342	Crow	5.5	16 Apr./86	335
1856	Crow	2.7	9 Mar./86	304	Crow	3.5	23 Apr./86	310
1872	Crow	0.1	9 Mar./86	303	Crow	1.0	17 Apr./86	304
1874	Crow	0.1	9 Mar./86	386	Old	322.0	21 Apr./86	386
1876	Crow	0.1	9 Mar./86	276	Crow	5.0	23 Apr./86	285
1984	Crow	10.0	6 Mar./86	407	Crow	11.7	25 Apr./86	405
1987	Crow	10.0	6 Mar./86	370	Crow	10.5	24 Apr./86	367
2357	Old	329.7	11 Mar./86	379	Crow	1.0	17 Apr./86	378
2818	Crow	7.3	16 Apr./86	485	Crow	10.0	25 Apr./86	484
3941	Crow	10.0	24 Apr./86	425	Crow	11.7	25 Apr./86	
7858	Crow	13.2	5 Oct./85	445	Crow	13.0	25 Apr./86	430
7987	Crow	5.0	4 Oct./85	352	Crow	5.0	23 Apr./86	356
				Brown Trout				
1406	Crow	13.2	20 Sep./85	467	Crow	12.6	8 Apr./86	449
*3386	Old	313.0	8 Apr./86	376	Old	318.0	21 Apr./86	385
7968	Crow	7.3	4 Oct./85	318	Crow	3.6	17 Apr./86	317
7860	Crow	11.5	5 Oct./85	443	Crow	11.3	24 Apr./86	445
7879	Crow	9.3	5 Oct./85	392	Crow	5.5	16 Apr./86	395
				Mountain Whitefish				
1391	Old	333.3	18 Aug./85	327	Old	338.0	20 Apr./86	325
1516	Crow	5.5	20 Aug./85	329	Crow	13.0	25 Apr./86	315
1521	Crow	5.5	20 Aug./85	318	Crow	10.5	24 Apr./86	319
1577	Old	348.0	21 Aug./85	271	Crow	12.6	8 Apr./86	264
1771	Old	330.7	19 Oct./85	288	Crow	11.7	25 Apr./86	289
1792	Crow	13.5	6 Mar./86	412	Crow	5.5	16 Apr./86	416
1794	Crow	13.5	6 Mar./86	318	Crow	14.0	24 Apr./86	312
1939	Crow	8.2	9 Mar./86	326	Crow	7.5	16 Apr./86	324

Continued . . .

Table 5.5 Continued.

Tag No.	Release River	Release Location (km)	Release Date	Release Length (mm)	Recapture River	Recapture Location (km)	Recapture Date	Recapture Length (mm)
Mountain Whitefish (Cont'd)								
1957	Crow	10.7	6 Mar./86	390	Crow	10.0	25 Apr./86	385
1983	Crow	10.0	6 Mar./86	424	Crow	11.7	25 Apr./86	425
2567	Old	328.5	11 Mar./86	298	Crow	1.0	17 Apr./86	302
2649	Old	329.7	11 Mar./86	297	Crow	4.5	16 Apr./86	286
2676	Crow	4.1	16 Apr./86	293	Crow	5.0	23 Apr./86	293
2721	Crow	12.6	8 Apr./86	315	Crow	13.0	24 Apr./86	305
2785	Crow	8.3	16 Apr./86	315	Crow	8.0	23 Apr./86	300
2811	Crow	7.3	16 Apr./86	309	Crow	5.0	23 Apr./86	309
2890	Old	330.7	17 Apr./86	300	Old	331.0	20 Apr./86	
2891	Old	330.7	17 Apr./86	276	Old	331.0	20 Apr./86	
*3175	Old	312.5	3 Mar./86	295	Old	318.0	21 Apr./86	296
*3277	Old	314.0	7 Mar./86	295	Crow	7.8	16 Apr./86	325
3916	Crow	11.3	24 Apr./86	320	Crow	11.0	25 Apr./86	
3919	Crow	11.3	24 Apr./86	307	Crow	11.0	25 Apr./86	
3920	Crow	11.3	24 Apr./86	331	Crow	11.0	25 Apr./86	
3923	Crow	11.3	24 Apr./86	286	Crow	11.0	25 Apr./86	
3935	Crow	11.0	24 Apr./86	326	Crow	11.0	25 Apr./86	
3939	Crow	11.0	24 Apr./86	401	Crow	11.7	25 Apr./86	
**5868	Old	315.5	1 May/86	290	Old	334.0	20 Apr./86	305
**5921	Old	319.0	30 Apr./86	259	Old	318.0	21 Apr./86	271
7868	Crow	11.4	5 Oct./85	371	Crow	1.0	17 Apr./86	363
7871	Crow	10.3	5 Oct./85	429	Crow	6.5	16 Apr./86	424
7883	Cas	7.0	10 Oct./85	314	Cas	17.0	14 Apr./86	317
7884	Cas	7.0	10 Oct./85	360	Crow	6.5	16 Apr./86	358
7887	Cas	7.0	10 Oct./85	252	Crow	8.5	16 Apr./86	243
Bull Trout								
2600	Old	324.0	12 Mar./86	545	Old	323.5	21 Apr./86	540
2892	Old	330.5	17 Apr./86	567	Old	328.0	20 Apr./86	

*Tagged by Environmental Management Associates.
**Tagged by IEC Beak Consultants Ltd.

movement may have represented a downstream dispersal following spawning or may have been a negative response to capture and tagging stress. One rainbow trout tagged on 16 April at Km 7.3 on the Crowsnest River was recaptured at Km 10.0 on 25 April, a net upstream movement of 2.7 km.

Four of the five brown trout were recaptured in the Crowsnest River; all had been tagged in the Crownest River in the fall of 1985. A brown trout was recaptured (i.e., on 21 April) in the Oldman River at Km 318 (i.e., upstream of the damsite); this individual was tagged and released by Environmental Management Associates on 8 April at Km 313 below the damsite.

The distribution of the 33 mountain whitefish recaptured was as follows: Crowsnest River (26), Oldman River (6), and Castle River (1). Of the 26 mountain whitefish recaptured in the Crowsnest River during April 1986, 19 had been tagged earlier in the Crowsnest River (i.e., August-October 1985 (4), March 1986 (5), April 1986 (10)). Five of the recaptured mountain whitefish were tagged in the Oldman River ,i.e., August-October 1985 (2), March 1986 (3).. These individuals were tagged at diverse locations (i.e., ranging from the north fork section to below the damsite). The remaining two individuals had been tagged in the Castle River (Km 7.0) on 10 October 1985. Data collected during the October 1985 survey (O'Neil and Hildebrand 1986) indicates that these individuals may have been part of a spawning concentration in the Castle River.

Six mountain whitefish were recaptured in the Oldman River; one was recaptured in the Castle River. Of the six collected in the Oldman River all had been tagged earlier in the Oldman River. Movements past the damsite were displayed by two individuals (i.e., Tag No.'s 3175 and 5868). The mountain whitefish recaptured in the Castle River was tagged in the Castle River on 10 October 1985. This individual was likely part of a spawning concentration in the vicinity of Km 7.0 (O'Neil and Hildebrand 1986).

Two bull trout were recaptured in the Oldman River; both had been tagged previously in the Oldman River (March and April 1986).

5.5 LENGTH DISTRIBUTION OF SPORTFISH POPULATIONS

The length distributions of sportfish populations based on the electrofishing catch are presented in Figures 5.13-5.16.

Fig.5.13 Rainbow trout length-freq.

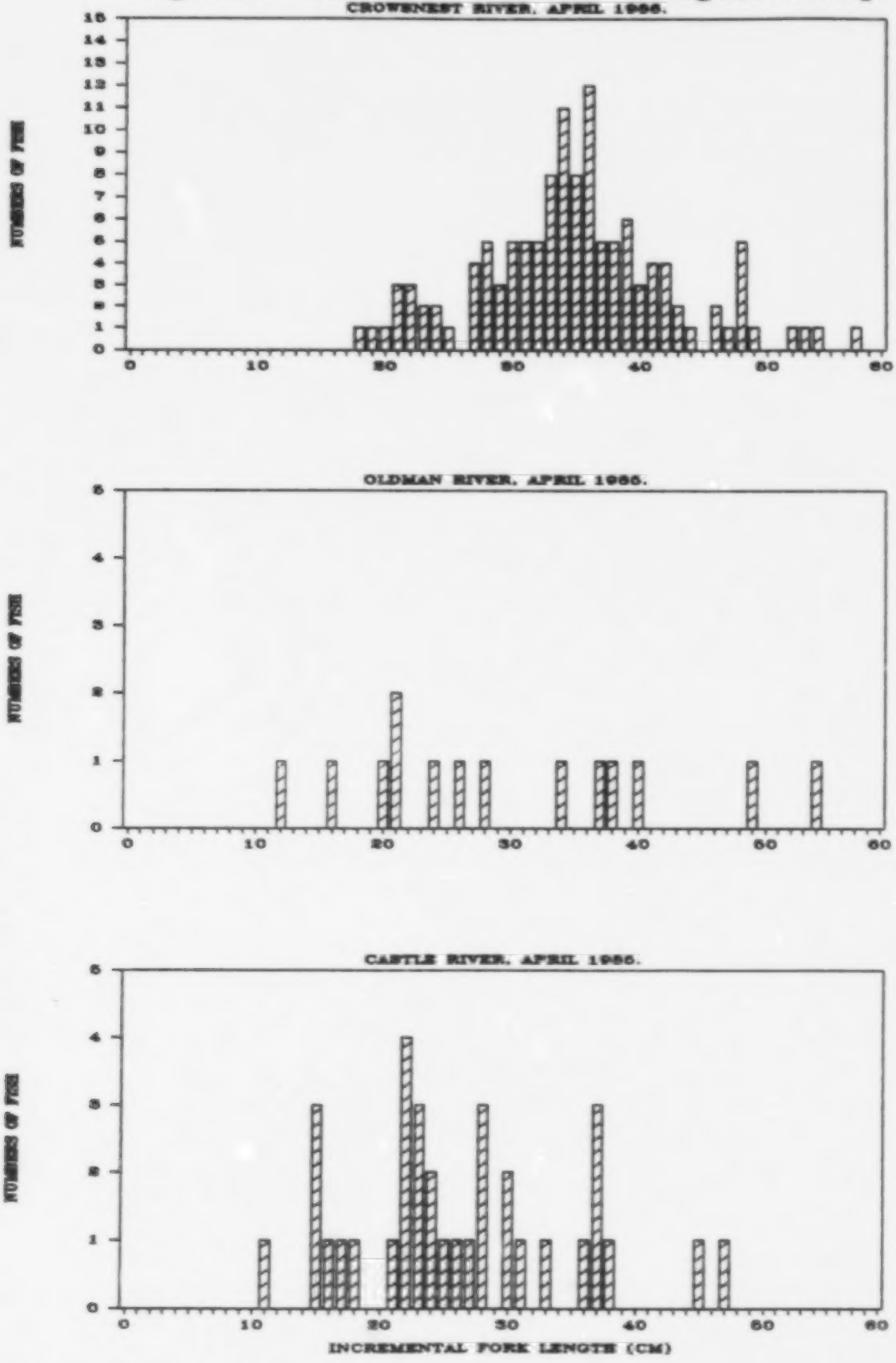
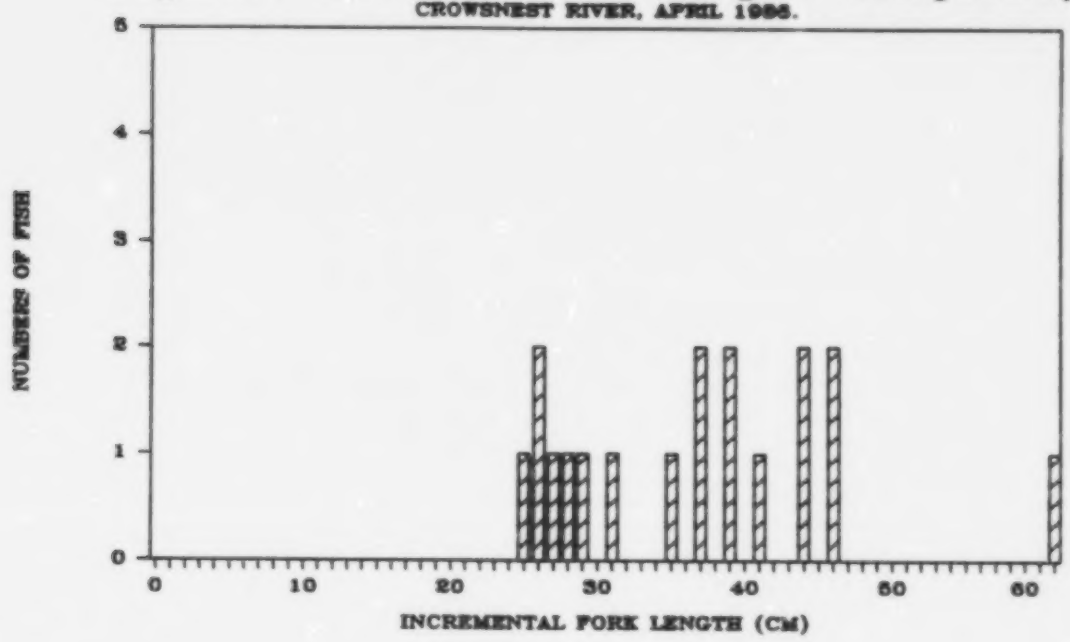

CROWSNEST RIVER, APRIL 1986.
NUMBERS OF FISH
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 10 20 30 40 50 60
OLDMAN RIVER, APRIL 1986.
NUMBERS OF FISH
0 1 2 3 4 5 6
0 10 20 30 40 50 60
CASTLE RIVER, APRIL 1986.
NUMBERS OF FISH
0 1 2 3 4 5 6
0 10 20 30 40 50 60
INCREMENTAL FORK LENGTH (CM)

Fig.5.14 Brown trout length-frequency.



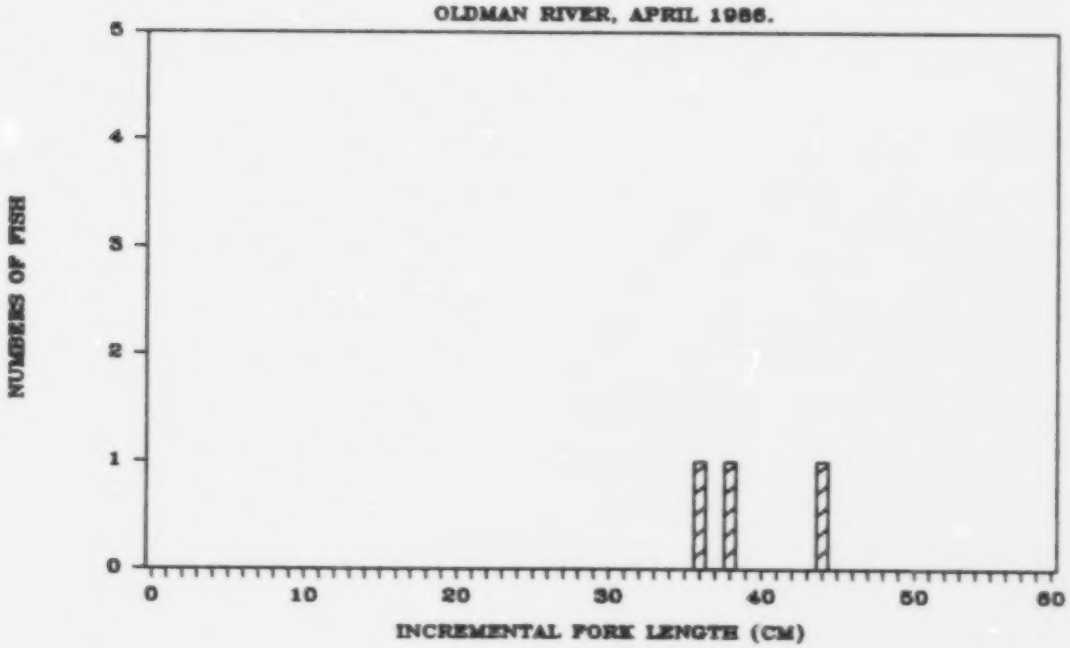


Fig.5.15 Mountain whitefish length-freq.

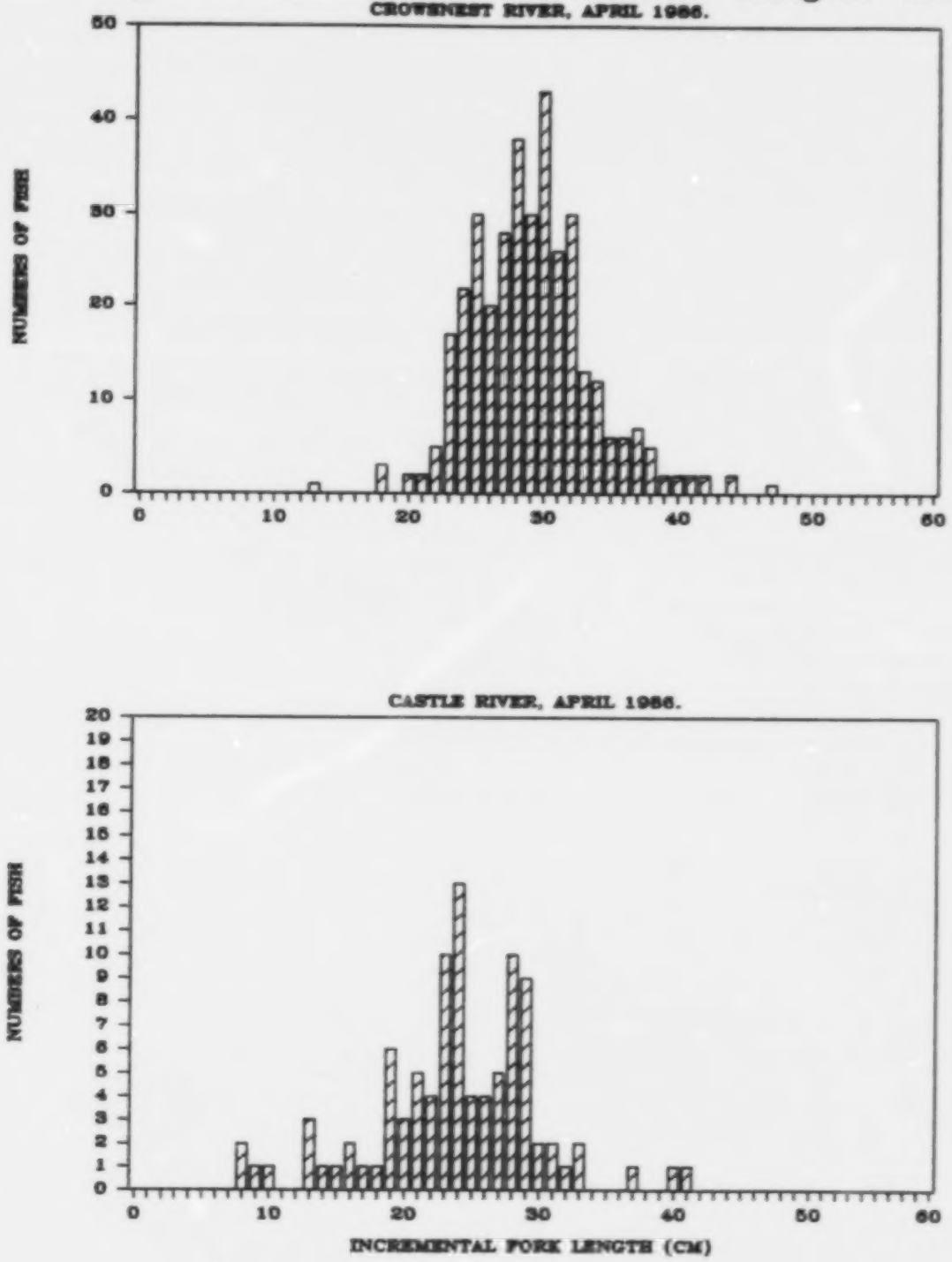
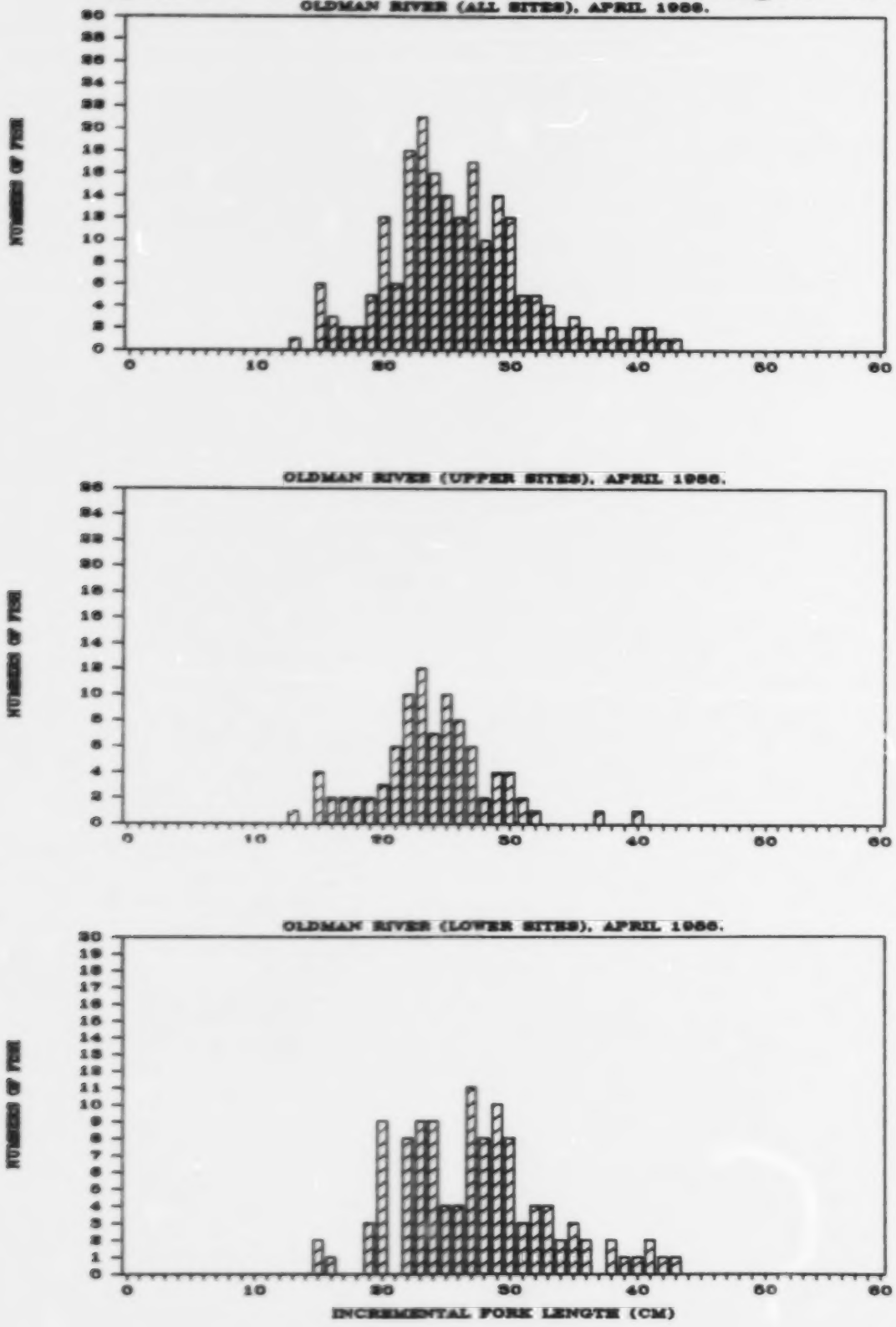


Fig.5.16 Mountain whitefish length-freq.


OLDMAN RIVER (ALL SITES), APRIL 1986.
OLDMAN RIVER (UPPER SITES), APRIL 1986.
OLDMAN RIVER (LOWER SITES), APRIL 1986.
NUMBER OF FISH
INCREMENTAL FORK LENGTH (CM)

SECTION 6.0

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O'Neil, J.P., L. Hildebrand. 1986. Fishery resources upstream of the Oldman River Dam. Prep. for Alta. Environ., Planning Div. by R.L. & L. Environmental Services Ltd. 131 p + Appendices.

Platts, W.S., W.F. Megahan, and O.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. U.S. Dep. Agric., Forest Serv., Intermountain Forest and Range Exp. Stn. Ogen, Utah. Gen. Tech. Rep. INT-138.

APPENDIX A

Water Temperature Data

Table A1 Daily water temperatures recorded in the Crowsnest River (km 2.5), 25 March to 29 April 1986.

Date		AM		PM	
		Time	Temp. (°C)	Time	Temp. (°C)
March	25	0830	1.5	1730	5.0
	26	0745	2.0	1830	6.0
	27	0745	4.5	1745	10.0
	28	0800	5.0	1800	10.0
	29	0800	4.0	1845	8.0
	30	0800	5.0	1830	4.0
	31	0745	2.0	1900	4.0
April	1	0945	3.0	1830	5.0
	2	0800	3.5	1900	6.0
	3	0800	2.0	1900	8.0
	4	0800	1.0	1845	6.0
	5	0800	2.0	1830	7.0
	6	0800	1.5	1830	7.0
	7	0745	1.5	1815	8.0
	8	0730	6.5	1830	10.0
	9	0730	3.0	1815	8.0
	10	0715	4.0	1830	4.0
	11	0715	0	1800	1.0
	12	0800	0	1745	0
	13	0800	0	1800	2.0
	14	0730	0	1800	4.0
	15	0700	0	1900	6.0
	16	0700	2.0	1800	7.0
	17	No Data		No Data	
	18	0730	1.5	1815	5.0
	19	0745	2.0	1830	7.0
	20	0730	4.0	1815	6.0
	21	0800	5.0	1845	10.0
	22	0715	5.0	1830	11.0
	23	0715	3.5	1800	5.0
	24	0730	1.0	1845	7.0
	25	0715	3.0	2000	4.0
	26	0730	4.0	1815	7.0
	27	0745	4.0	1800	10.0
	28	0715	4.0	1845	8.0
	29	0730	3.0	1800	7.5

Table A2 Stream temperatures (spot measurements) recorded in the Oldman River Dam Study Area.

Date	Time (h)	Site (km)	Water Temp. (°C)
Crowsnest River			
9 April	1030	13.9	7.0
	1230	13.9	8.0
	1515	12.5	10.0
10 April	1030	9.1	6.0
	1630	10.3	8.0
11 April	1100	9.1	3.0
12 April	1030	16.1	0
	1530	2.1	2.0
13 April	0930	12.5	0.5
	1800	4.2	3.5
14 April	1045	9.1	0.5
16 April	1100	9.1	6.0
	1300	8.3	8.0
	1645	4.2	9.5
17 April	1015	4.2	4.5
	1345	2.1	8.0
	1630	4.2	9.0
18 April	0950	4.2	5.0
	1545	4.2	7.0
19 April	1000	4.2	5.0
	1900	4.2	8.0
20 April	1100	4.2	7.0
	1815	4.2	10.5
21 April	1650	4.2	13.5
22 April	1120	4.2	10.0
23 April	1100	4.2	4.0
	1630	4.2	4.0
24 April	1140	13.9	3.5
	1530	9.1	8.0
25 April	1100	9.1	4.5
	1300	9.1	7.0
Castle River			
13 April	1830	14.9	2.5
14 April	1130	24.1	2.5
15 April	1030	14.9	4.0
	1530	7.5	7.0
	1800	0	7.0
23 April	1000	14.9	3.0
Oldman River			
13 April	1815	330.5	3.5
17 April	1550	330.5	9.5
19 April	1030	351.5	6.0
	1730	339.1	10.0
20 April	1130	339.1	7.0
21 April	1130	325.0	10.0
	1430	316.0	12.5

APPENDIX B

Habitat Type Description and Rating System

Appendix B
STREAM HABITAT EVALUATION
Habitat Type Description and Rating

A) Riffle - Portion of channel with increased velocity relative to Run and Pool habitat types; broken water surface due to effects of submerged or exposed bed materials; relatively shallow (less than 50 cm) during moderate to low flow periods.

Riffle (RF) - Typical riffle habitat type; limited submerged or overhead cover for juveniles and adult life stages; coarse substrate.

Riffle-Boulder garden (RF/BG) - Riffle habitat type with significant occurrence of large boulders; availability of significant instream cover for juveniles (to lesser extent adults) at moderate to high flow events.

B) Rapids (RA) - Portion of channel with highest velocity relative to other habitat types. Deeper than Riffle; often formed by channel constriction. Substrate extremely coarse; dominated by large cobble and boulder material. Instream cover provided in pocket eddies (P3) and associated with cobble/boulder substrate.

C) Run - Portion of channel characterized by moderate to high current velocity relative to Pool and Flat habitat; water surface largely unbroken. Deeper than Riffle habitat type. Can be diffentiated into four types: deep-slow, deep-fast, shallow-slow and shallow-fast.

Run (Class 1) (R1) - Highest quality Run habitat type. Maximum depth exceeding 1.5 m; average depth 1.25 m or greater. High instream cover at all flow conditions (submerged boulders/bedrock fractures, depth). Generally of deep-slow type (to lesser extent deep-fast) and situated proximal to upstream food production area (i.e., RF, R3).

Run (Class 2) (R2) - Moderate quality Run habitat type. Maximum depth reaching or exceeding 1.0 m but generally in order of 0.75 m. High instream cover during all but low flow events (baseflow). Generally of either deep-fast type or moderately deep-slow type.

Run (Class 2)/Boulder garden (R2/BG) - Moderate quality Run habitat type; presence of large boulders in channel; high instream cover (boulder, bedrock fractures, turbulence) at all but low-flow events (baseflow). Depth characteristics similar to R2; however required maximum depth lower due to cover afforded by boulders.

Run (Class 3) (R3) - Lowest quality Run habitat type. Maximum depth of 0.75 m but averaging only 0.5 m. Low instream cover at all but high flow events. Generally of shallow-fast or shallow-slow types.

Run (Class 3)/Boulder garden (R3/BG) - Similar to R3 in depth and velocity characteristics; presence of large boulders in channel offers improved instream cover during moderate and high flow events.

D) Flat (F1) - Area of channel characterized by low current velocities (relative to RF and Run cover types); near-laminar (i.e., non-turbulent) flow character. Depositional area featuring predominantly sand/silt substrate. Differentiated from Pool habitat type on basis of high channel uniformity and lack of direct riffle/run association. More depositional in nature than Run habitat (sand/silt substrate, lower food production, low cover, etc.).

E) Pool - Discrete portion of channel featuring increased depth and reduced velocity (downstream oriented) relative to Riffle and Run habitat types.

Pool (Class 1) (P1) - Highest quality Pool habitat type. Maximum depth exceeding 1.5 m; average depth 1.25 m or greater; high instream cover at all flow-conditions (submerged boulder, bedrock fractures, depth, bank irregularities). Generally featuring high Riffle and/or Run association (i.e., food input). Often intergrades with deep-slow type of R1.

Pool (Class 2) (P2) - Moderate quality Pool habitat type. Maximum depth reaching or exceeding 1.0 m but generally in order to 0.75 m. High instream cover at all but low flow events (baseflow).

Pool (Class 3) (P3) - Low quality pool habitat type. Maximum depth of 0.75 m but averaging only 0.5 m. Low instream cover at all but high flow events. Includes small pocket eddy type of habitat.

F) Features - Includes instream features that add to diversity and overall habitat quality.

Chutes (CH) - Areas of channel constriction; generally resulting in channel deepening and increased velocity. Associated habitat types are RA, R1, R2.

Ledges (LG) - Areas of bedrock intrusion into the channel; often creates Chutes and Pool habitat.

APPENDIX C

Bull Trout and Major Non-Sport Species, Electrofishing Results

Table C1 Numbers of bull trout and major non-sport species (longnose and white suckers) captured and observed during boat electrofishing surveys in the Oldman River Dam Study Area, April 1986.

River	Sampling Section	Date	Sample Distance (km)	No. Caught/Observed		
				Bull Trout	Longnose Sucker	White Sucker
Crowsnest R.	ES1	17 April	4.1	0	71	2
		23 April	4.1	0	45	5
	ES2	16 April	5.0	1	33	4
		23 April	5.0	0	41	2
	ES3A	24 April	3.5	0	22	2
		25 April	3.5	0	5	1
	ES3	9 April	1.2	0	2	0
		24 April	1.6	0	2	0
		25 April	1.2	0	3	0
	Subtotal			1	224	16
Oldman R.	ES1A	17 April	1.0	1	10	5
		20-21 April.	15.5	4	79	17
	ES1	20 April	7.4	1	8	0
	ES2A	19 April	6.0	1	3	0
	ES2	19 April	6.4	0	3	0
	Subtotal			7	103	22
Castle R.	ES1	15 April	13.3	8	12	2
	ES2	14 April	9.1	0	12	0
	Subtotal			8	24	2
Grand Total				**16**	**351**	**40**